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Heating Piping & Air Conditioning

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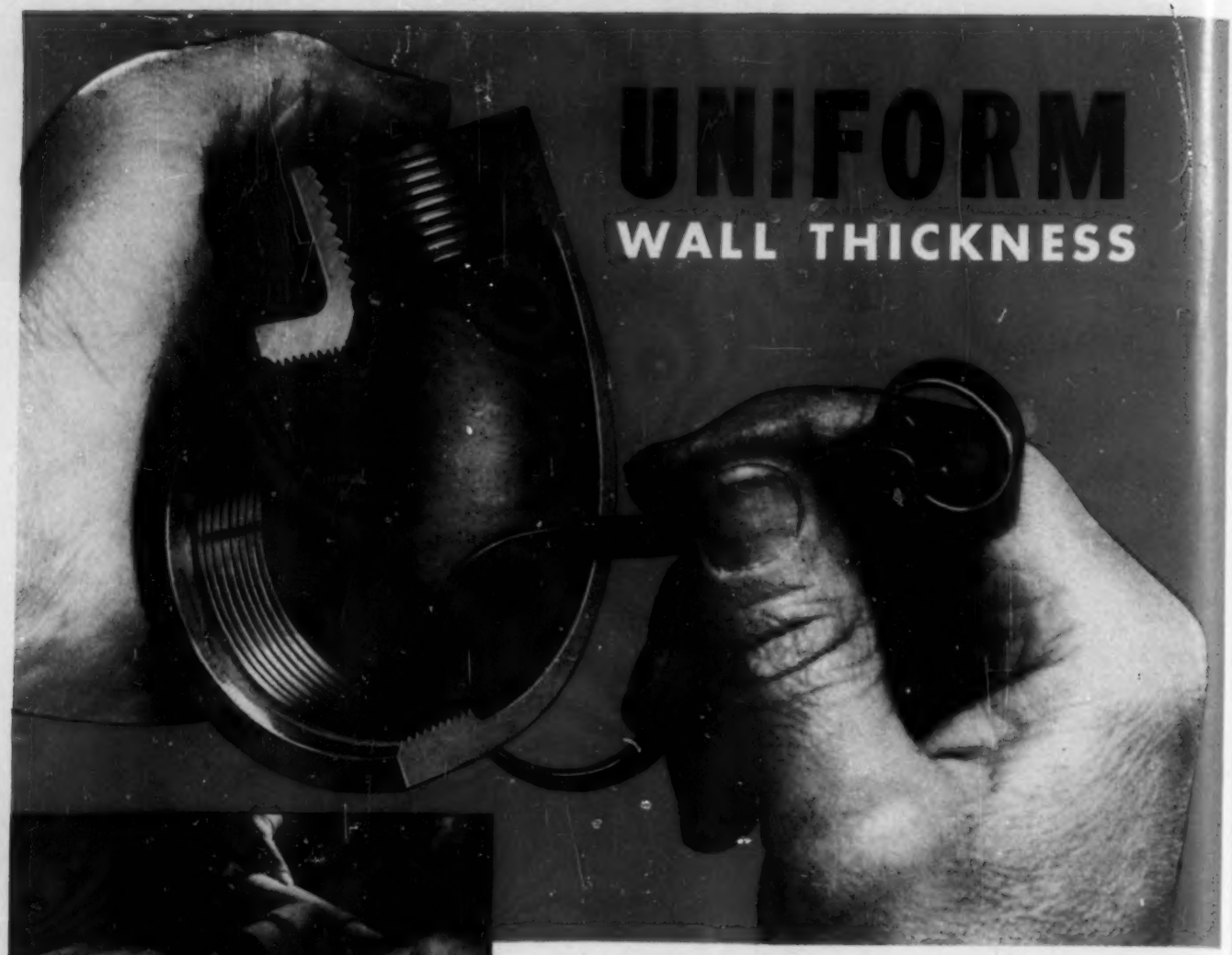

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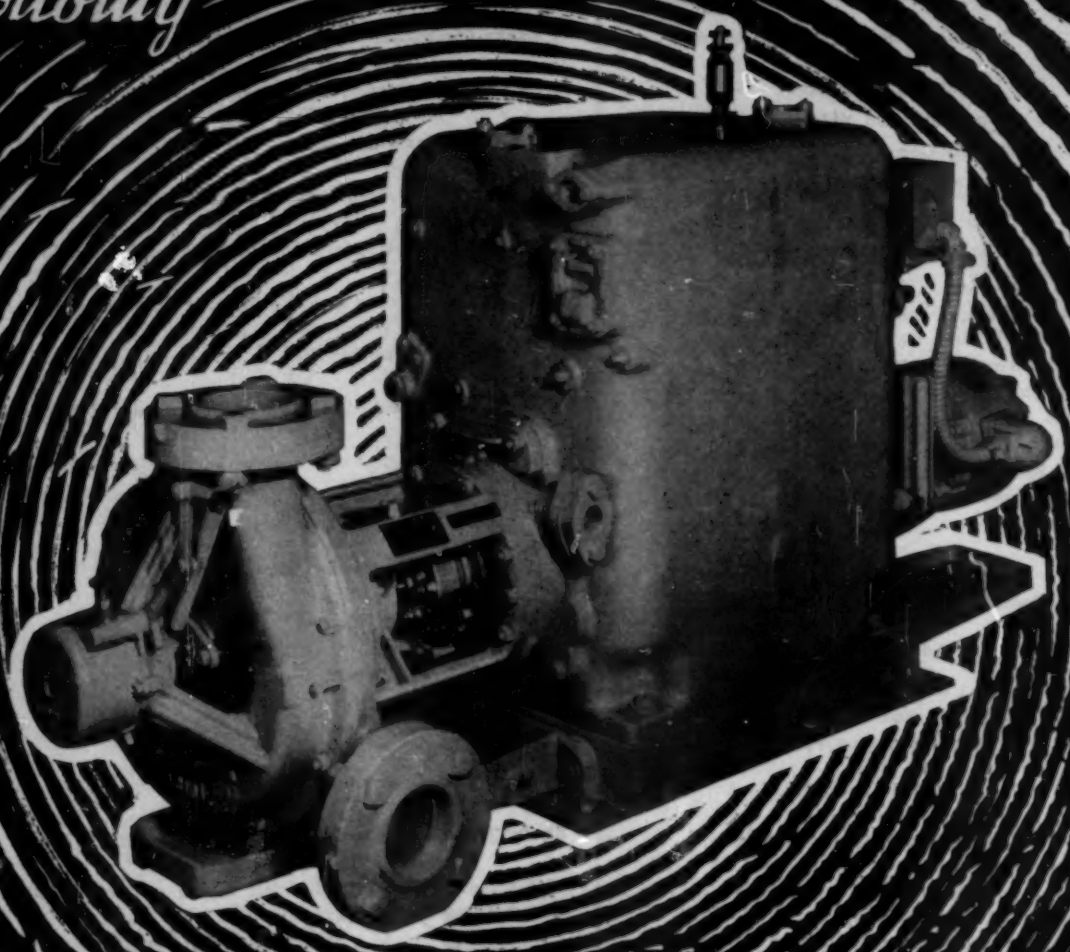
Centralized Heating Economy



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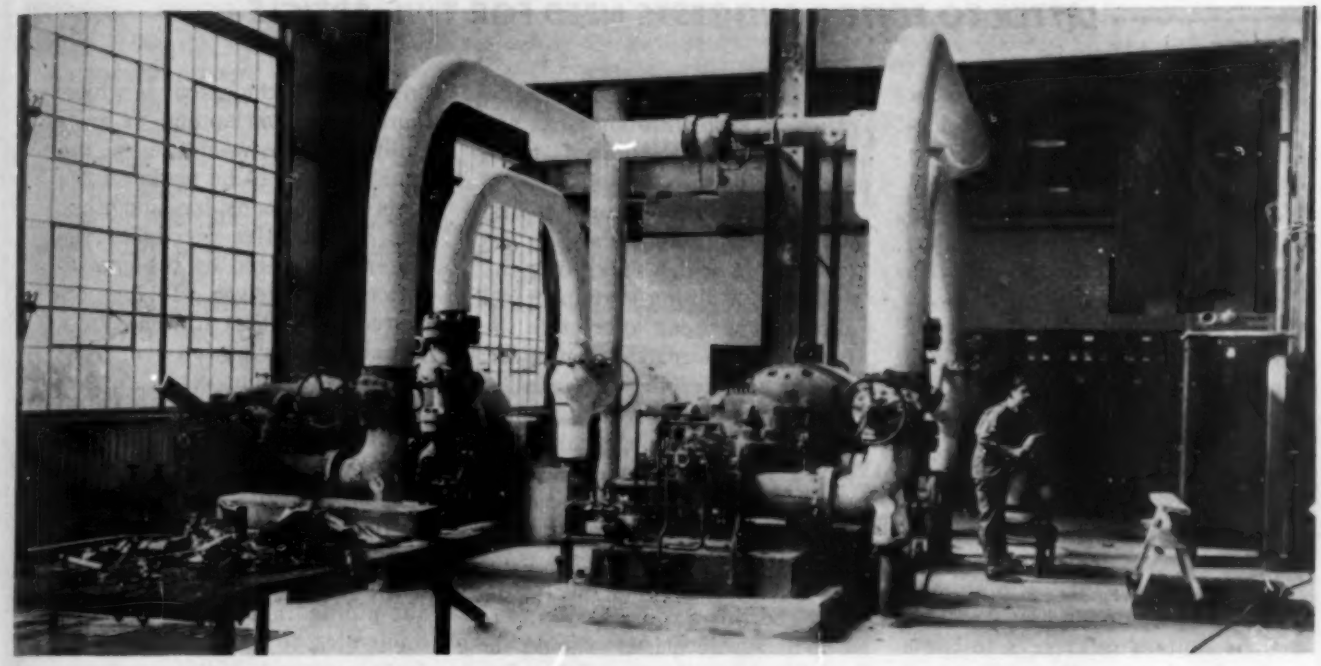

Suction and discharge water piping connections to two high pressure boiler feed pumps

Which Specifications for STEEL PIPE Shall I Use ?

SABIN CROCKER CLARIFIES POWER PIPING STANDARDS

AS STATED in the letter on the next page, there are several ASTM specifications for pipe listed in the American Standard Code for Pressure Piping and the ASME Boiler Construction Code as available for power piping applications. After eliminating nonferrous and cast iron pipe as outside the scope of the present discussion, the 10 separate specifications abstracted in Table 1 remain for consideration. These 10 specifications embrace some 54 different grades of material. In order to simplify the present discussion it will be confined to steel pipe, without attempting to go into the choice of specifications for cast or forged flanges, fittings, and valve bodies.

Some idea of the purposes for which the several specifications are suited can be gathered from their *titles* with condensed *scope clauses* as presented in Table 1. The order of listing specifications follows the sequence of the ASTM numbering system and merely reflects the succession in which the specifications were issued. This order seems preferable to attempting to have the sequence follow an ascending quality scale, because so many factors are involved that it is impracticable to say that one specification necessarily represents a better product from every angle than does some other specification. It so happens, however, that the carbon steel specifications were issued in an earlier sequence before the alloy steel specifications appeared.

General Criteria of Suitability

In general, the *quality* of the product is reflected in the extent to which *chemical composition* and *physical properties* are specified. From a glance at Table 1 it is immediately evident which specifications have sufficient requirements to define adequately what the product is like and to assure obtaining reasonable uniformity of quality. Each length of every kind of pipe made has to withstand successfully a hydrostatic test considerably in excess of its allowable working pressure without splitting or developing leaks. In the case of pipe for "ordinary uses," such as A 120, this is the only test to which it is subjected.

Further indications of *quality* are the *process* by which the steel is made and the *melting practice*.

LETTER TO EDITOR SUGGESTS NEED FOR THIS ARTICLE

THE NEED FOR information on how to choose the right specification for any particular power piping application was pointed out in the following letter to HPAC's editor from a reader, who is mechanical engineer with a power company:

"You are doubtless aware of the multiplicity of specifications covering pipe materials. The booklet of ASTM Specifications for Steel Piping Materials contains 10 separate sets of specifications applicable to steel pipe for power plant service. Likewise, the American Standard Code for Pressure Piping and the ASME Boiler Construction Code contain references to these specifications and set *S* values for the materials. In addition, there are other specifications covering pipe made of other marials, as well as covering various forgings, castings, etc., intended to be suitable for use in connection with piping systems. Also, I understand that the ASTM is now getting out an additional set of specifications covering chrome-moly pipe for high temperature service.

"I do not question the necessity for, nor the wisdom of having, these various specifications. There are, of course, sound technical reasons for use of materials suitable for specific applications, and it is well known that materials which are good for some specific applications are either unsuitable or uneconomical for certain other applications. In addition to the technical and economic considerations, there are sometimes commercial or practical reasons which make it necessary or desirable to have some duplication of specifications or materials which might be suitable for a given use. However, the average engineer is faced with all these different specifications which require close and careful study to determine just wherein, or in what respects, they differ from each other, and, furthermore, it is quite likely to be difficult properly to evaluate or determine the true significance of such differences as are found between some of these specifications.

"Without attempting to go into details here regarding all the factors which enter into the design of a piping system, I feel sure that you can appreciate the fact that the ordinary engineer, who is not a piping specialist or a metallurgist but who is responsible for use of large quantities of piping properly designed for a number of different operating conditions such as are encountered in the modern steam plant and in some industrial plants, may be in a quandary as to which specifications should be employed in selecting piping materials for the plant, as well as how to determine the relative merits of the various specifications for piping which might possibly be used for a given application or for a given job. For example, there seem to be at least four different specifications which are applicable for piping for high temperature service, but I do not know of any well defined method of determining the relative merits of them, or which should be used for a given application or set of conditions. Likewise, there appears to be about half a dozen specifications covering pipe materials suitable for ordinary service, but with no well defined rules as to when, or under what conditions, each one is more suitable than another.

"I have felt the need of some kind of comprehensive discussion which would furnish definite information and establish facts and principles which could be readily utilized for determining which of the various specifications should be used for purchasing pipe materials for any given installation or set of conditions. Such a discussion should point out just what the difference is between materials obtained under each of the various specifications, and the service or conditions for which each is supposed to be more particularly suitable; also the extent to which there is an overlapping of suitability, which would leave the final selection to be made on the basis of some consideration other than the relative merits of the materials covered by the specifications themselves. It has occurred to me that it would be a valuable contribution on your part if you could get a number of experts in the piping field, including well informed committee members of the various standards associations, leading metallurgists, production men, commercial representatives, and technical experts of the imporant piping fabricators and steel companies, to write the pertinent facts required for the purpose outlined above. It might even be possible to work up a table showing the relative merits as well as the undesirable qualities of materials covered by the various piping material specifications for various purposes or applications."

This letter has very clearly stated the need for information that will be of direct interest to many concerned with power piping. In the present article, Sabin Crocker (senior mechanical engineer, system engineering department, The Detroit Edison Co., and a member of HPAC's board of consulting and contributing editors) discusses the question, "Which Specification Shall I Use for Steel Pipe?" From long association with various American Standards Association and American Society for Testing Materials committees concerned with piping codes, specifications, and standards, Mr. Crocker is in a position to contribute helpful slants on the questions outlined. Among other committee affiliations, Mr. Crocker is chairman of the subcommittee on metallurgy and piping of the prime movers committee of the Edison Electric Institute, and chairman of the subcommittee on scope and intent, American Standard Code for Pressure Piping, ASA B31.

By "process" is meant the bessemer, open hearth, electric furnace, or duplexing process of manufacture used in producing the steel. "Melting practice" refers to whether the steel is an "open" or "rimmed" steel, or whether it is "killed" or deoxidized during the process of manufacture. "Killed" steels are superior in many respects, among other things being of more uniform structure and better adapted to cold bending and to severe hot forming operations.

Both *aluminum* and *silicon* are commonly used together as *deoxidizers*, and each has a specific effect on the final product. The aluminum tends to give a fine grained steel which behaves well in rolling but has poor resistance to graphitization in service owing to the aluminum. The silicon, on the other hand, tends to give a coarse grained steel having superior strength at elevated temperatures and less susceptibility to graphitization. Hence, it is sometimes specified that a steel shall be "killed with a preponderance of silicon" and a requirement is set as to the minimum amount of silicon which must be found present on analysis. This requirement, however, does not prevent the use of an excessive amount of aluminum from the standpoint of graphitization, and more specific restrictions should be considered in ordering new pipe if carbon steel is to be used for temperatures above 800 F, or carbon-moly above 900 F. Several of the specifications shown in Table 1 have minimum silicon requirements and it will be noted that these grades are allowed higher *S* values than similar materials having less silicon (see, for instance, A106).

Another preliminary slant on the purposes for which the several specifications are suited can be obtained from the allowable stresses or "*S* values" at different temperatures listed in Table 1 for the various grades of material. The *S* values are the maximum allowable stresses at different operating temperatures set by the code committees for use in the formulas for computing the thickness of pipe wall required with respect to bursting stress due to internal pressure. In the Code for Pressure Piping, the *S* values also serve as a guide in setting maximum longitudinal stress caused by a combination of internal pressure, and bending due to expansion and dead weight between supports. Tabulating these *S* values on the same sheet with the chemical compositions, physical properties, and other characteristic information pertaining to each grade of material helps to make its salient features distinguishable from the corresponding features of other grades. For instance, no *S* values have been provided in the codes for A120 pipe above 450 F, which is deemed to be the top temperature for this kind of pipe, whereas no *S* values below 650 F have been provided for the alloy steels in power piping—since there would be no advantage in using them at increased cost where high temperature or corrosion is not a factor.

HOW IS THE engineer to determine readily which of the many available specifications should be used for purchasing pipe materials for any given installation or set of conditions? This informative discussion, and the consolidated tabulation of chemical compositions, physical properties, and allowable stresses, has been especially prepared (as the result of a suggestion to HPAC's editor) to answer this question, and will be found of great value to all who design, specify, or install power piping systems.

Owing to space limitations, no *S* values have been shown for temperatures above 1000 F, although such values have been set in the Boiler Code for some alloys. Likewise several sets of *S* values for intermediate temperatures have been omitted for the sake of condensing the table.

The *joint or seam efficiency* possessed by each kind of pipe was considered by the code committee in setting *S* values. Seamless pipe, being without a longitudinal joint, naturally has an efficiency of 100 per cent. Electric resistance welded pipe is ordinarily rated at 85 per cent joint efficiency, but for applications where the temperature is below 650 F and where the pipe is subjected to supplementary tests and/or heat treatments which demonstrate the strength characteristics of the weld to be equal to the minimum tensile strength specified for the pipe, *S* values equal to the corresponding seamless grades may be used. Electric fusion welded A155 pipe, where the quality of welding is thoroughly tested, is allowed a joint efficiency of 90 per cent, whereas electric fusion welded A139 pipe made under less exacting requirements is given a joint efficiency of only 80 per cent, the same as lap welded pipe. Butt welded pipe has the lowest joint efficiency of all, 60 per cent, which is in keeping with the strength of that kind of seam. These joint efficiencies are incorporated in the *S* values shown in Table 1.

Carbon Steel Pipe for Ordinary Uses

Among the specific points raised by our reader is "there appears to be about half a dozen specifications covering pipe materials suitable for ordinary service, but with no well defined rules as to when, or under what conditions, each one is more suitable than another." Leaving out specifications for nonferrous pipe and other special materials not generally applicable to power piping, this point boils down to choosing between A53, A120, A135, and A139 (see Table 1). The following review of the distinguishing features of these specifications would seem in order:

Specification A120 is the lowest grade of steel pipe for which there is an ASTM specification. No physical tests are specified beyond a hydrostatic test, and there are no chemical requirements whatsoever except requirements for galvanizing where this is desired. As stated in the scope paragraph, A120 pipe is intended for "ordinary uses in steam, water, gas, and air lines, but is not intended for close coiling or bending, or high temperature service." This is the "common or garden variety" of pipe purchased from jobbers' stock without a pedigree. That A120 pipe is at the bottom of

Table 1—Consolidated table of chemical compositions, physical properties, and allowable stresses for steel pipe used for power piping

ASTM Serial Designation	Type	Process[1]	Chemical Composition: Carbon max %	Manganese %	Phosphorus max %	Sulphur max %	Silicon %	Nickel %	Chromium %	Molybdenum %	Tungsten or Vanadium %	Physical Properties[2]: Tensile Strength min psi	Yield Point min psi	Elongation, Basic Longitudinal: In 8 in., min %	In 2 in., min %	Allowable Stresses or S-Values, psi For Temperatures (Condensed)[3] of not to Exceed: 150F	450F	650F	750F	850F	950F	1000F
A53	Welded[4] and Seamless Carbon-Steel Pipe Intended for[6] Bending, Coiling, Flanging (Except for Butt-Welded), and Other Special Purposes, and Suitable for Fusion Welding																					
	Butt-Welded	Acid-Bessemer										50 000	30 000	18		6 750	5 950	5 400	4 700			
	Lap-Welded	Acid-Bessemer										50 000	30 000	18		9 400	8 150	7 300	6 250			
	Lap-Welded	OH or EF			0.06							45 000	25 000	20	30	9 400	8 150	7 300	6 250			
	ERW Grade A	OH or EF			0.045							48 000	30 000		35	None Listed						
	ERW Grade B	OH or EF			0.045							60 000	35 000		30	None Listed						
	Seamless Grade A	Acid-Bessemer			0.11							48 000	30 000		35	None Listed						
	Seamless Grade A	OH or EF			0.045							48 000	30 000		35	12 000	10 560	9 600	8 250	5 850	2 600	1 350
	Seamless Grade B	Acid-Bessemer			0.11							60 000	30 000		30	None Listed						
	Seamless Grade B	OH or EF			0.045							60 000	30 000		30	15 000	13 200	12 000	9 950	6 350	2 600	1 350
A106	Seamless Carbon-Steel Pipe for High-Temperature Service With Supplementary Requirements where a Superior Grade of Pipe is Required[5]																					
	Seamless Grade A	OH or EF	0.25	0.30 to 0.90	0.04	0.06						48 000	30 000		35	12 000	10 560	9 600	8 250	5 850	2 600	1 350
	Seamless Grade A	OH or EF Silicon Killed[6]	0.25	0.30 to 0.90	0.04	0.06	0.10 to 0.25					48 000	30 000		35	12 000	10 560	9 600	8 700	6 850	3 800	2 000
	Seamless Grade B	Acid-Bessemer	0.25	0.35 to 1.00	0.11	0.06	0.10 min					60 000	35 000		30	None Listed						
	Seamless Grade B	OH or EF Silicon Killed	0.35	0.35 to 1.00	0.04	0.06	0.10 min					60 000	35 000		30	15 000	13 200	12 000	10 400	7 400	3 800	2 000
A120	Black and Hot-Dipped Zinc-Coated (Galvanized) Welded[4] and Seamless Carbon-Steel Pipe For Ordinary Uses in Steam, Water, Gas, and Air Lines (Not Including Flanging, Close-Coiling or Bending																					
	Butt-Welded	AB or OH														6 500	5 700					
	Lap-Welded	AB or OH														8 800	7 600					
	Electric-Welded	AB, OH, or EF														None Listed						
	Seamless	AB, OH or EF														10 800	9 600					
A135	Electric-Resistance-Welded Carbon-Steel Pipe[7] Intended for Conveying Liquid, Gas, or Vapor. Grade A only is Adapted for Flanging and Bending																					
	ERW Grade A	OH or EF			0.045	0.060						48 000	30 000		35	10 200	8 950	8 150	7 000	4 950	2 200	1 150
	ERW Grade B	OH or EF			0.045	0.060						60 000	35 000		30	12 750	11 200	10 200	8 450	5 400	2 200	1 150
A139	Electric-Fusion-Welded Carbon-Steel Pipe, Sizes 4 in. to 24 in. Inclusive Intended for Conveying Liquid, Gas, or Vapor. Grade A only is Adapted for Flanging and Bending																					
	EFW Grade A	OH or EF			0.045	0.060						48 000	30 000		30	9 600	8 400					
	EFW Grade B	OH or EF			0.045	0.060						60 000	35 000		25	12 000	10 560					
A155	Electric-Fusion-Welded Carbon-Steel Pipe for High-Temperature and High-Pressure Service Intended for Bending, Flanging, Corrugating, and Similar Forming Operations																					
	EFW Grade A	OH or EF	0.15 to 0.17	0.35 to 0.60	0.05 Acid 0.04 Basic	0.05	0.10 min.					45 000	24 000	33		10 100	8 900	8 100	7 550	5 150	2 350	1 200
	EFW Grade B	OH or EF	0.20 to 0.22	0.35 to 0.60	0.05 Acid 0.04 Basic	0.05	0.10 min					50 000	27 000	30		11 250	9 900	9 000	8 100	5 400	2 350	1 200
	EFW Grade C	OH or EF	0.25 to 0.30	0.30 to 0.60	0.05 Acid 0.04 Basic	0.05	0.10 min					55 000	27 500	27		12 400	10 900	9 900	8 550	5 700	2 350	1 200
	EFW Grade A	OH or EF Silicon Killed[6]	0.15 to 0.17	0.35 to 0.60	0.05 Acid 0.04 Basic	0.05	0.10 to 0.25					45 000	24 000	33		10 100	8 900	8 100	7 550	6 000	3 400	1 800
	EFW Grade B	OH or EF Silicon Killed[6]	0.20 to 0.22	0.35 to 0.60	0.05 Acid 0.04 Basic	0.05	0.10 to 0.25					50 000	27 000	30		11 250	9 900	9 000	8 100	6 250	3 400	1 800
	EFW Grade C	OH or EF Silicon Killed[6]	0.25 to 0.30	0.30 to 0.60	0.05 Acid 0.04 Basic	0.05	0.10 to 0.25					55 000	27 500	27		12 400	10 900	9 900	8 550	6 500	3 400	1 800

ASTM Serial Designation	Type	Process[1]	Chemical Composition: Carbon max %	Manganese %	Phosphorus max %	Sulphur max %	Silicon %	Nickel %	Chromium %	Molybdenum %	Tungsten or Vanadium %	Physical Properties[2]: Tensile Strength min psi	Yield Point min psi	Elongation, Basic Longitudinal: In 8 in., min %	In 2 in., min %	Allowable Stresses or S-Values, psi For Temperatures (Condensed)[3] of not to Exceed: 150F	450F	650F	750F	850F	950F	1000F
A158	Seamless Alloy-Steel Pipe for High-Temperature Service																					
	Ferritic P3a	OH or EF	0.15	0.10 to 0.60	0.04	0.05	0.45 to 0.75		1.50 to 2.00	0.60 to 0.80		60 000	30 000		30	Boiler Code	12 000	12 000	11 200	8 000	5 850
	Ferritic P3b	OH or EF	0.15	0.30 to 0.60	0.03	0.03	0.50 max		1.75 to 2.25	0.45 to 0.65		60 000	30 000		30	Boiler Code	12 000	12 000	11 200	8 000	5 850
	Ferritic P5a	OH or EF	0.15 or 0.20	0.50 max	0.03	0.03	0.50 max		4.00 to 6.00	0.45 to 0.65	0.75 to 1.25 W	60 000	30 000		30	Boiler Code	12 000	12 000	11 200	8 000	5 850
✓	Ferritic P5b	OH or EF	0.15	0.50 max	0.03	0.03	1.00 to 2.00		4.00 to 6.00	0.45 to 0.65		60 000	30 000		30	None Listed					
	Ferritic P5c[9]	OH or EF	0.12	0.50 max	0.03	0.03	0.50 max		4.00 to 6.00	0.45 to 0.65		60 000	30 000		30	Piping Code	12 000	12 000	11 200	8 000	5 850
✓	Ferritic P6	OH or EF	0.12	0.50 max	0.03	0.03	0.50 max		12.00 to 15.00		2.50 to 3.50 W	60 000	30 000		30	None Listed					
✓	Ferritic P11	OH or EF	0.15	0.30 to 0.60	0.04	0.05	0.50 to 1.00		1.00 to 1.50	0.45 to 0.65		60 000	30 000		30	Boiler Code	12 000	12 000	11 200	8 000	5 850
✓	Ferritic P15	OH or EF	0.15	0.30 to 0.60	0.04	0.045	1.15 to 1.65			0.45 to 0.65		60 000	30 000		30	None Listed					
	Austenitic P8a	OH or EF	0.08	2.00 max	0.03	0.03	0.75 max	8.00 to 11.00	18.00 to 20.00			75 000	30 000		50	Boiler Code	15 000	14 600	14 000	12 300	10 000
	Austenitic P8b[10]	OH or EF	0.08	2.00 max	0.03	0.03	0.75 max	9.00 to 13.00	17.00 to 20.00			75 000	30 000		50	Boiler Code	15 000	14 600	14 000	12 300	10 000
✓	Austenitic P8d[11]	OH or EF	0.08	2.00 max	0.03	0.03	0.75 max	9.00 to 13.00	17.00 to 20.00			75 000	30 000		50	None Listed					
A206	Seamless Carbon-Molybdenum Alloy-Steel Pipe for High-Temperature Service Suitable for Bending, Flanging, and Similar Forming Operations and for Fusion Welding																					
	Ferritic P1	OH or EF	0.10 to 0.20	0.30 to 0.60	0.04	0.05	0.10 to 0.50			0.45 to 0.65		55 000	30 000		30	Boiler Code or Piping Code	11 000	11 000	10 500	8 000	5 000
A213	Seamless Alloy-Steel Boiler and Superheater Tubes (These Materials are Sometimes Specified for Pipe for High-Temperature Service and Made to Nominal Pipe Size)																					
	Ferritic T3	Elect. Furnace	0.15	0.40 to 0.60	0.03	0.03	0.45 to 0.75		1.50 to 2.00	0.60 to 0.80		60 000	25 000		30	Boiler Code	12 000	12 000	11 200	8 000	5 850
	Ferritic T5	Elect. Furnace	0.15	0.50 max	0.03	0.03	0.50 max		4.00 to 6.00	0.45 to 0.65		60 000	25 000		30	Boiler Code	12 000	12 000	11 200	8 000	5 850
	Ferritic T11	Elect. Furnace	0.15	0.30 to 0.60	0.03	0.03	0.50 to 1.00		1.00 to 1.50	0.45 to 0.65		60 000	25 000		30	Boiler Code	12 000	12 000	11 200	8 000	5 850
	Ferritic T12	Elect. Furnace	0.15	0.30 to 0.60	0.04	0.04	0.30 max		0.80 to 1.10	0.45 to 0.65		60 000	25 000		30	Boiler Code	12 000	12 000	11 200	8 000	5 850
	Ferritic T13	Elect. Furnace	0.15	0.50 max	0.03	0.03	1.00 to 2.00		4.00 to 6.00	0.45 to 0.65		60 000	25 000		30	Boiler Code	12 000	12 000	11 000	6 000	4 200
	Ferritic T14	Elect. Furnace	0.15	0.30 to 0.60	0.03	0.03	0.50 max		1.75 to 2.25	0.45 to 0.65		60 000	25 000		30	Boiler Code	12 000	12 000	11 200	8 000	5 850
	Ferritic T16[12]	Elect. Furnace	0.12	0.50	0.03	0.03	0.50 max		4.00 to 6.00	0.45 to 0.65		60 000	25 000		30	Boiler Code	11 000	11 000	10 800	8 000	5 850
	Ferritic T17	Elect. Furnace	0.15 to 0.25	0.30 to 0.60	0.04	0.045	0.15 to 0.30		0.80 to 1.10		0.15 min V	60 000	25 000		30	Boiler Code	12 000				
	Ferritic T21	Elect. Furnace	0.15	0.30 to 0.60	0.03	0.03	0.50 max		2.75 to 3.25	0.80 to 1.00		60 000	25 000		30	Boiler Code	12 000	12 000	11 200	8 250	6 250
	Ferritic T22	Elect. Furnace	0.15	0.30 to 0.60	0.03	0.03	0.50 max		2.00 to 2.50	0.90 to 1.10		60 000	25 000		30	Boiler Code	12 000	12 000	11 200	8 250	6 250
	Austenitic TP-304	Elect. Furnace	0.08	2.00	0.03	0.03	0.75 max	8.00 to 11.00	18.00 to 20.00			75 000	30 000		35	Boiler Code	15 000	14 600	14 000	12 300	10 000
	Austenitic TP-316	Elect. Furnace	0.08	2.00	0.03	0.03	0.75 max	11.00 to 14.00	16.00 to 18.00	2.00 to 3.00		75 000	30 000		35	Boiler Code	15 000	14 600	14 000	12 600	11 200
	Austenitic TP-321[13]	Elect. Furnace	0.08	2.00	0.03	0.03	0.75 max	9.00 to 13.00	17.00 to 20.00			75 000	30 000		35	Boiler Code	15 000	14 600	14 000	12 300	10 000
	Austenitic TP-347[14]	Elect. Furnace	0.08	2.00	0.03	0.03	0.75 max	9.00 to 13.00	17.00 to 20.00			75 000	30 000		35	Boiler Code	15 000	14 600	14 000	12 300	10 000
A280	Seamless Chrome-Molybdenum Alloy-Steel Pipe for High-Temperature Service Suitable for Bending, Flanging, and Similar Forming Operations and for Fusion Welding																					
	Seamless	OH or EF	0.10 to 0.20	0.30 to 0.60	0.04	0.05	0.10 to 0.30		0.40 to 0.60	0.45 to 0.65		55 000	30 000		30	Boiler Code	11 000	11 000	10 500	8 000	5 000

See footnotes on second page following.

the scale for steel pipe also is evident from the fact that it has the lowest *S* values assigned any kind of steel pipe in the respective grades, and that no *S* values are given for temperatures above 450 F. Butt welded pipe may be furnished under A120 in sizes from ⅛ in. up to and including 4 in. in "standard weight" and "extra strong" thicknesses, and up to 3 in. in "double extra strong." Lap welded pipe is not made in sizes below 1¼ in. Electric welded and seamless are made in the full size range. Either black or hot dipped galvanized pipe is available under this specification.

The next better quality of steel pipe for ordinary uses is electric fusion welded covered by ASTM specification A139, which is made with either straight seam or spiral seam. This kind of pipe is furnished in grades A and B in sizes from 4 in. to 24 in., inclusive, and in thickness conforming to the ASA B36.10 schedule number system. Straight seam or spiral seam welded pipe in diameters 30 in. and larger and in thicknesses up to ¾ in. can be ordered to ASTM specification A134. Chemical requirements consist of maximum limits on phosphorus and sulphur, and physical properties are specified for grades A and B. Such pipe is used to a limited extent for power piping and has been assigned *S* values for temperatures up to 450 F. The principal use for A134 and A139 welded pipe, however, is for underground gas, oil, or water lines and for such purposes it usually is given a protective coating as specified by the purchaser.

Carbon Steel Pipe for Intermediate Uses

Coming between pipe for "ordinary uses" and pipe suitable for "high temperature" service, there is an intermediate kind adapted to coiling, bending, flanging, and other special purposes, and suitable for fusion welding. Such pipe is satisfactory for intermediate uses in power piping at service temperatures up to 750 F. The two principal ASTM specifications in this field are A53 and A135, as discussed below.

Specification A53 covers black and hot dipped galvanized steel pipe

Spherical fitting used in steam line from the boiler to the turbine on the 60,000 kw turbogenerator unit in a modern plant. The boiler is designed for a drum pressure of 975 psi and the turbine is designed for steam at 850 psi and 900 F total temperature at the throttle. The boiler feed pump discharge pressure is approximately 1100 psi when pumping 310 degree water

which may be butt welded, lap welded, electric resistance welded, or seamless. Butt welded pipe is not made in nominal sizes larger than 4 in. and is not intended for flanging. Lap welded pipe is not made below 1¼ in. size. Electric welded and seamless are made in the full size range. When seamless or electric resistance welded pipe is ordered for close coiling, cold bending, or for forge welding, grade A should be specified rather than grade B. The chemical requirements of this specification cover only the maximum phosphorus content, aside from the fact that a carbon maximum of 0.10 per cent is set for resistance welded pipe of ⅛ and ¼ in. nominal size. The tensile requirements and bending and flattening tests of A53 are good, but only one of these tests has to be made on one length of pipe from each lot of 500 lengths or fraction thereof in each size. Hence these tests are not so searching as those specified under the optional supplementary requirements of A106, where transverse tensile and flattening tests may be made on *both* ends of *every* length of pipe if specified in the order.

It often happens that seamless A53 pipe is fundamentally identical with A106 pipe, but has not been subjected to all the physical tests and chemical analyses required by A106. Hence, where A106 pipe is desired but none is available, it is sometimes possible to locate A53 pipe in stock and give it sufficient tests to demonstrate whether or not it conforms to A106 requirements.

The Code for Pressure Piping has limited *S* values for A53 pipe to temperatures 750 F and below, although the Boiler Code shows values for seamless A53 pipe up to 1000 F. In the light of what is now known about graphitization, however, it does not seem advisable to use A53 pipe at temperatures above 750 F unless it is silicon killed, with a restriction placed on the amount of aluminum used, and certainly not above the temperature range recommended for A106 material.

Specification A135 covers grade A and grade B electric resistance welded steel pipe 30 in. and under in diameter. Only grade A is adapted to flanging and bending. The suitability of electric resistance welded pipe for various purposes is somewhat dependent upon its dimensions, properties, and conditions of service, so that the purpose for which the pipe is intended should be stated in the order. The Code for Pressure Piping and the Boiler Code Committees have assigned *S* values to electric resistance welded pipe for temperatures up to 750 F and 1000 F, respectively, based on a joint efficiency of 85 per cent. For applications where the temperature is below 650 F and where the pipe is subjected to supplementary tests and/or heat treatments which demonstrate the strength characteristics of the weld to be equal to the minimum tensile strength specified for the pipe, *S* values equal to the corresponding seamless grades (of A53) may be used.

Carbon Steel Pipe for High Pressure, High Temperature Service

The outstanding carbon steel specification for high pressure

and/or high temperature service is ASTM A106. In its 1945 issue, this specification will be restricted to seamless pipe suitable for bending, flanging, and similar forming operations, and for fusion welding. Grade A rather than grade B should be used for close coiling, cold bending, or for forge welding. The purpose for which the pipe is to be used should be stated in the order. While A106 pipe is suitable for moderate superheated steam temperatures, the principal demand for this product in modern central stations is for the boiler feed lines which usually operate at temperatures below 500 F. It is also used extensively for extracted steam lines, high pressure saturated steam piping, lubricating oil lines for turbines, and similar purposes where a thoroughly dependable product is required.

Owing to the susceptibility of carbon steel to graphitization at temperatures above 800 F, caution should be exercised in using this material at too high a temperature. Silicon killed, low aluminum carbon steel has both a higher creep strength and a greater resistance to graphitization than has the variety killed with a preponderance of aluminum. The higher *S* values shown in Table 1 for the silicon killed varieties of A106 pipe were originally assigned on account of the superior creep strength of this material in the higher temperature range. Present indications are that, from a graphitization standpoint, the silicon killed variety of A106 can be used at temperatures up to 800 or 825 F, whereas the variety killed with a preponderance of aluminum should be restricted in power piping applications to service where the temperature does not much exceed 750 F. Although average temperatures are important in considering graphitization, due attention should be paid to operating temperature swings, as a great deal of damage can be done in a relatively few hours time if the temperature is allowed to get out of hand.

Specification A106 has rather complete chemical requirements, abstracted in Table 1, as well as physical properties determined by tensile, bending, and flattening tests. Owing to the small lots in which A106 pipe is ordered, a greater number of test specimens are usually required than is the case with specification A53. There are requirements for finish that describe surface defects and define when they can be corrected by machining or grinding and when they constitute a basis for rejection. There also are supplementary requirements of an optional nature which may be specified in ordering pipe 8 in. and over in nominal diameter. These provide for check analysis on each length, if desired, and for a transverse tension test, a flattening test, and an etch test on both ends of each length. These tests are expensive, but they are much more searching than the usual routine tests and practically insure finding and eliminating any defective length or lengths.

The need for testing individual lengths of pipe intended for severe service conditions became apparent several years ago when it was found that pipe containing laminations sometimes passed unnoticed if only one or two lengths from each lot were tested. As a result of this experience, and in order to satisfy the exacting needs of the power industry, supplementary requirements of an optional nature that could be specified if and as required were then added to A106. These tests have proved to be a most effective means for detecting and eliminating faulty lengths of pipe, and the added expense is amply justified for high pressure piping. As mentioned in discussing specification A53, seamless A53 pipe often is fundamentally identical with A106 pipe but has not been subjected to all the physical tests and chemical analyses required by A106. Hence, it may be possible, should occasion arise, to qualify A53 pipe for A106 service by giving it the additional A106 tests.

Alloy Steel Power Piping

Some years ago when superheated steam temperatures first approached a point where the use of alloy steel pipe seemed called for from a strength standpoint, the ASTM undertook to formulate specification A158 as a collection of requirements for the most promising grades of steel for this purpose. In addition to the grades still remaining in A158, it originally included as grade P1 the ½ per cent molybdenum steel (carbon-moly) which was issued later as a separate specification designated as A206. The reason for this change was the indication then that carbon-moly would be the predominant steel for some time to come, which actually proved to be the case. Only since the discovery three years ago that graphitization is a factor to be considered, has there been much interest in other alloy steels for power piping. Like specification A106 for carbon steel pipe, alloy

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Footnotes for Table 1 on second and third preceding pages.

[1]Abbreviations: *AB*, acid bessemer; *EF*, electric furnace; *EFW*, electric fusion welded; *ERW*, electric resistance welded; *OH*, open hearth.

[2]In addition to the tests specified, each length of pipe shall be given a hydrostatic test and other physical tests as prescribed in the respective specification.

[3]For intermediate *S* values, see American Standard Code for Pressure Piping, ASA B31, or ASME Boiler Construction Code. The Boiler Code *S* values below 650 F are the same as at 650 F in all cases, whereas the Piping Code values are as tabulated. Allowable stresses for A53 and A135 pipe above 750 F are for the Boiler Code only; likewise those for non-silicon-killed A155 pipe at 1000 F. The Boiler Code also contains silicon-killed varieties of the following items for which there is no equivalent in the Piping Code: (a) A53 seamless pipe in both grades A and B to which it assigns the same *S* values as shown for silicon-killed A106 pipe in this table; and (b) A135 resistance welded pipe.

[4]Welded pipe 4 in. and under in nominal diameter may be butt welded. Welded pipe over 4 in. in nominal diameter shall be lap welded or electric welded.

[5]Grade A pipe should be used for close coiling, cold bending, or forge welding.

[6]Not shown in the ASTM specification, but can be obtained with this silicon range.

[7]For applications where the temperature is below 650 F, *S* values equal to the corresponding seamless grades may be used if the pipe is subjected to supplemental tests and/or heat treatments which demonstrate the strength of the weld to be equal to the minimum tensile strength specified for the pipe.

[8]Either molybdenum or tungsten shall be used.

[9]Grade P5c shall have a titanium content of not less than four times the carbon content and not more than 0.70 per cent; or a columbium content of eight to 10 times the carbon content.

[10]Grade P8b shall have a titanium content of not less than five times the carbon content and not more than 0.60 per cent.

[11]Grade P8d shall have a columbium content of not less than 10 times the carbon content and not more than 1.0 per cent.

[12]Grade T16 shall have a titanium content of not less than four times the carbon content and not more than 0.70 per cent.

[13]Grade TP-321 shall have a titanium content of not less than five times the carbon content and not more than 0.60 per cent.

[14]Grade TP-347 shall have a columbium content of not less than 10 times the carbon content and not more than 1.00 per cent.

pipe specifications A158, A206, and A280 contain requirements as to the extent of surface defects permissible as well as optional requirements for tests which can be made on each length of pipe if called for in the order.

Carbon-Moly Pipe: It should be mentioned that about the time carbon-moly pipe was switched from being the P1 grade of A158 to become A206, a change was made in the deoxidizing practice followed in "killing" the steel. The A158 variety, in which 1½ to 2 lb of aluminum was used per ton of steel in killing, tended to have a fine grain and an abnormal structure, whereas the A206 version, killed with a preponderance of silicon and only about ½ lb of aluminum per ton, tended to have a coarse grain and a normal structure. This difference in melting practice was found to have a considerable effect on the susceptibility to graphitization, as noted earlier in this article.

Experience differs as to just what upper temperature limits should be prescribed for these two types of carbon-moly steel, but in most cases nothing worse than "scattered graphite" has been found after 30,000 to 40,000 hr service with the "high aluminum" variety if the operating temperature swings do not exceed 900 F, and with the "low aluminum" variety if they do not exceed 925 F. The existence of scattered graphite in existing installations is not alarming if it does not progress beyond this stage, but would seem to call for periodic sampling of welded joints to keep track of conditions. Before ordering a new rolling made of either kind of carbon-moly pipe, however, it would be advisable to see whether the temperature swings can be kept at least 25 F below those mentioned so as to be sure of staying on the safe side. Otherwise, consideration should be given to using another element as a graphitization inhibitor along with the molybdenum required for strength purposes at elevated temperatures. Some of the steels in current use at higher temperatures are discussed in succeeding paragraphs.

Chrome-Moly Pipe: The alloying element so far given the most consideration for adding to carbon-moly steel as a graphitization inhibitor is chromium, which gives promise of being effective if present in amounts from about ½ per cent on up. The presence of chromium in a steel helps to keep the carbon in combined form, thus tending to prevent the formation of graphite with prolonged exposure to elevated temperature. In view of the expectation that ½ per cent chromium added to a ½ per cent molybdenum steel would inhibit graphitization for operating temperatures up to 950 F or so, a special subgroup in the ASTM recently undertook formulation of a specification for pipe of this composition which will be issued as a 1945 tentative standard bearing the serial designation A280. The subcommittee on ferrous materials of the Boiler Code committee has already assigned tentative *S* values for this product, as shown in Table 1.

Where operating temperature swings are apt to exceed 950 F, some engineers feel that more than ½ per cent chromium might be desirable. In at least two instances of which the author is aware, this has been the reason for ordering pipe to the T12 grade of ASTM A213 (see Table 1) which contains 0.80 to 1.10 per cent chromium and is primarily a specification for superheater tubes. There is no corresponding grade P12 of A158 pipe, the nearest composition being grade P11 with 1 to 1½ per cent of chromium, which was considered more than necessary for the purpose. Furthermore, the silicon content of grade P11 (½ to 1 per cent) seems on the high side and might tend to detract from its creep strength. In at least one of the above mentioned orders a preference was expressed and realized for keeping the chromium content at the low end of its 0.80 to 1.10 per cent range in T12, among other reasons to facilitate welding. The actual fabrication is said to be working out with little more difficulty than would be experienced with A206 carbon-moly.

As operating temperatures approach 1000 F, more molybdenum is considered to be desirable from a strength standpoint, and more chromium for the sake of its corrosion resisting properties as well as for its value as a graphitization inhibitor. With steam pressures of 1200 to 1600 psi, there is considerable incentive for running the throttle temperature up to 1000 F—or at least letting the temperature swings go that high at maximum load on the unit. Severe service of this sort requires a steel which, at the operating temperature, is both stable and at the same time possesses sufficient strength to warrant having an *S* value commensurate with the pressure. In such applications, molybdenum is useful for its strength-giving properties, whereas chromium is desirable for resisting corrosion and as a means of inhibiting graphitization. The following varieties of chrome-moly steel are among the materials which have been used or are under discussion for this purpose (see Table 1):

Grade P3a of A158, 1.50-2.00 per cent chrome, 0.60-0.80 per cent moly, with 0.45 to 0.75 per cent silicon.

Grade P3b of A158, 1.75-2.25 per cent chrome, 0.45-0.65 per cent moly, with 0.50 per cent maximum silicon.

Grade P11 of A158, 1.00-1.50 per cent chrome, 0.45-0.65 per cent moly, with 0.50-1.00 per cent silicon.

Grade T12 of A213, 0.80-1.10 per cent chrome, 0.45-0.65 per cent moly, with 0.30 per cent maximum silicon.

Grade T22 of A213, 2.00-2.50 per cent chrome, 0.90-1.10 per cent moly, with 0.50 per cent maximum silicon.

Moly-Vanadium Pipe: As so often happens in choosing a satisfactory product for severe service conditions, opinions differ as to what constitutes an economic type of steel possessing adequate creep strength and at the same time being sufficiently resistant to graphitization and corrosion without getting into the field of the more expensive stainless and austenitic steels. One interesting possibility now under consideration is a 1.00 per cent molybdenum steel containing about 0.20 per cent vanadium. This steel is new to the piping field and is not covered by any existing specification—nor have any *S* values been set for it.

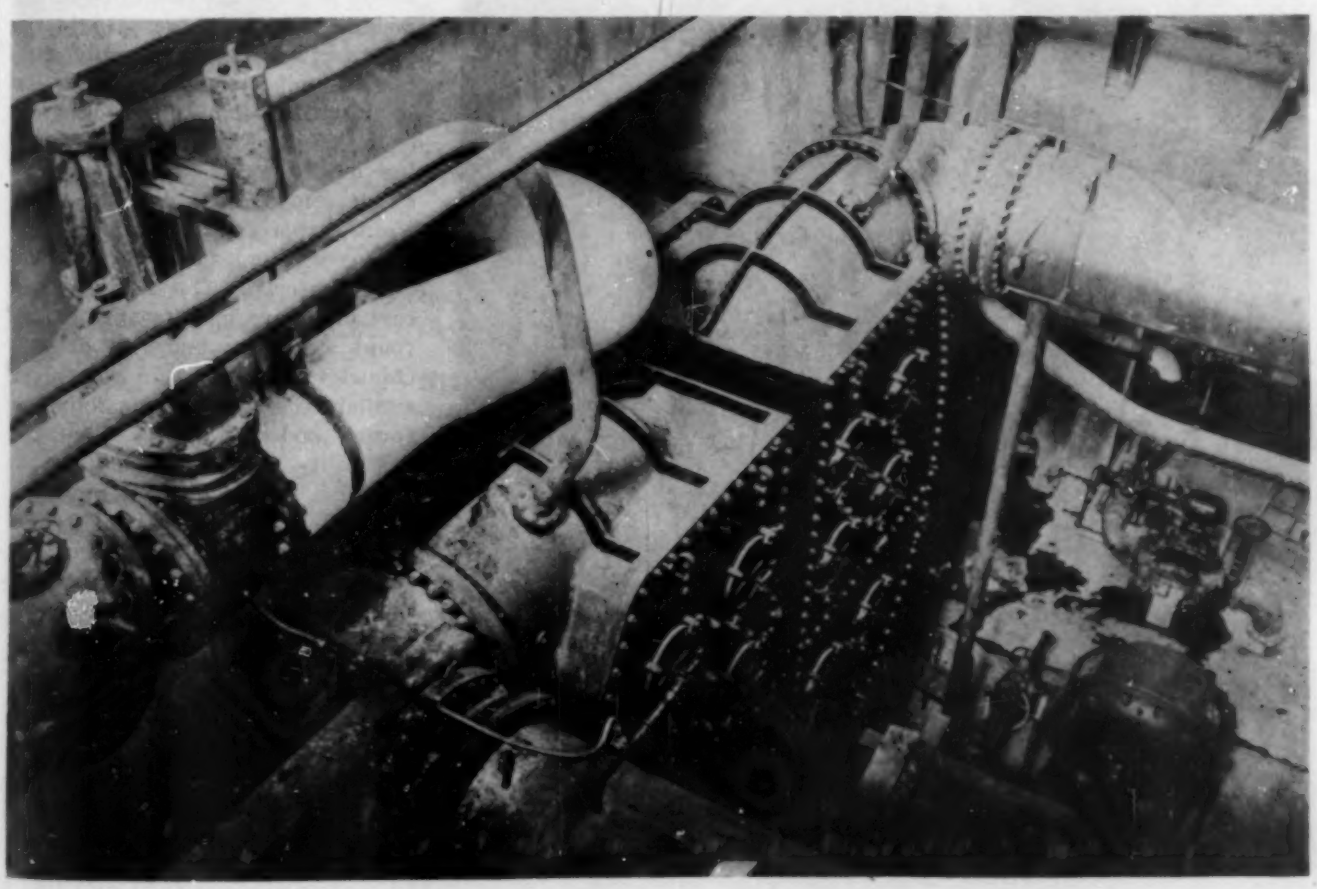
Corrosion Resistant Steels: Where corrosion is an important consideration, it is sometimes necessary to use the more expensive steels containing considerable amounts of chromium in conjunction with nickel or other alloying elements added for various reasons. It is of interest to note, however, that steam at temperatures up to 1000 F is not ordinarily found to be a corrosive medium. The 4-6

per cent chrome steel is the least expensive of those usually considered as really being corrosion resisting steels, beyond which there are other classes of ferritic steels in 7 to 9 per cent and the 12-15 per cent chromium ranges, and the 18 per cent chromium, 8 per cent nickel and richer alloys among the austenitic steels.

The austenitic chrome-nickel steels have not been used much for power piping owing to their cost and to the fact that other steels have served this purpose so far. Ferritic alloy steels containing considerable amounts of chromium, with or without other alloying elements, have been used extensively in the oil industry and in the high temperature end of steam superheater circuits, so that their properties are fairly well established. Intermediate and high alloy ferritic steels are definitely more difficult to weld, having air hardening tendencies which need to be counteracted by refinements in preheating and postheating technique and by other niceties of welding procedure carried out under careful control. The 4 to 6 per cent chrome steels in particular have pronounced air hardening tendencies which require special care in fabrication. Austenitic steels, on the other hand, do not air harden but are softened by quenching in air or water. Hence, strong, tough, and ductile welds are obtained in the austenitic steels without preheating or postheating, although joints are sometimes stress relieved to meet code requirements.

Welding of straight chromium ferritic steels is facilitated to some extent by the presence in the steel of certain elements, such as columbium or titanium, added in amounts having a definite ratio to the carbon content (see Notes 9-14 accompanying Table 1) which tend to reduce their tendency to air harden. The columbium or titanium also tend to stabilize the chromium by preventing it from oxidizing or from forming chromium carbide. This is a necessary precaution because these products, once formed, are apt to migrate to the grain boundaries and segregate there, thus embrittling the steel.

In welding chrome-nickel austenitic steels where air hardening is not a factor, the columbium or titanium acts solely as a stabilizer for holding the carbon in solution in the heat affected area adjacent to the weld. With service temperatures in the range of 800 to 1500 F, and particularly in the vicinity of 1200 F, the carbon in the iron-carbide of chrome-nickel austenitic steels has a pronounced tendency to come out of solution and unite with some of the chromium to form chromium carbides. This action is most pronounced along the grain boundaries where the attendant removal of chromium from solution in the ferrite tends to impair its corrosion resisting properties to an extent which permits the steel to become embrittled. The stabilizing elements serve to prevent the formation of chromium carbide by uniting, preferentially, with the precipitated



This indicates the variety of piping in a modern plant. Note the large cooling water pipes from the main surface condenser, the "priming" lines which are used for creating a vacuum in the water side of the condenser before starting up the circulating water pump, and a large steam extraction line which carries steam extraction from the main turbine to a closed feedwater heater. In the background are two pumps installed on the lower floor, one of which supplies cooling water for the generator hydrogen coolers and the turbine oil cooler and the other of which supplies high pressure water for sluicing ashes

carbon to form other carbides, thus leaving intact for resisting corrosion the chromium content already in solution in the steel.

Procurement Problems

Owing to the uncommon thicknesses and compositions required for high pressure and/or high temperature power piping installations, seamless pipe for this purpose is not generally stocked and often has to be bought on mill orders which are filled by special rollings. This introduces complications in that the footage of pipe usually required for any one job is considerably less than what is considered a normal mill rolling in any one size. This situation, of course, produces many headaches for purchasers, fabricators, and mill men alike. Some time back, a curtailed schedule of sizes and wall thicknesses was agreed on for carbon-moly pipe and inserted in specification A206 as Appendix I, with a view to reducing the variety of items ordered to an extent which would permit stocking at least some of them. The results of this laudable attempt at simplification have not been encouraging, however, and the problem is getting still more complicated owing to the increasing number of alloy compositions coming into use.

The aforesaid procurement difficulties have led in some instances to using other kinds of pipe instead of the seamless variety rolled by the usual Mannesmann or Pilger methods. One available substitute in the case of carbon steel is the high grade of electric fusion welded pipe made according to ASTM specification A155. This method is not so restricted by footage considerations and probably could be extended to the manufacture of some compositions of alloy pipe if and when needed.

Another way around the difficulty is to use forged and bored pipe, as has been done on several installations having "super" pressure and/or temperatures. Although expensive, this process is less hampered by footage requirements and has the added advantage of independence from established wall thicknesses. The latter consideration is of importance when the design calls for thicknesses beyond schedule 160 and double extra strong which usually are the upper limit for seamless rolling mills. The handicap of high cost for forged and bored pipe has been countered in some cases in the boiler-turbine unit system by getting the turbine throttle close to the superheater outlet and using a short, straight run of pipe between the two. In this arrangement, thermal expansion of the pipe can be accommodated by using a floating type of superheater outlet header which is free to move with the pipe.

A recent development which offers promise for filling small orders of pipe to any desired composition or wall thickness is the centrifugal casting method, by which hollow sections are cast in revolving molds similar to those used in the manufacture of centrifugally cast cast iron pipe. Nominal lengths are 16 ft, with available diameters from 3½ to 50 in. Electric furnace melting units supply steel of any desired composition ranging from plain carbon steel to high alloy, heat resisting, and corrosion resisting steels. The centrifugally cast pipes are heat treated in the rough condition and can be machined to dimension in a manner similar to that used for finishing forged and bored pipe. Another possibility under consideration is to finish the rough cast pipes by hot rolling through a seamless pipe mill. The suitability of centrifugally cast steel pipe for power piping purposes remains to be demonstrated and the most that can be said about it as yet is to point out its possibilities for getting around a difficult phase of the procurement problem.

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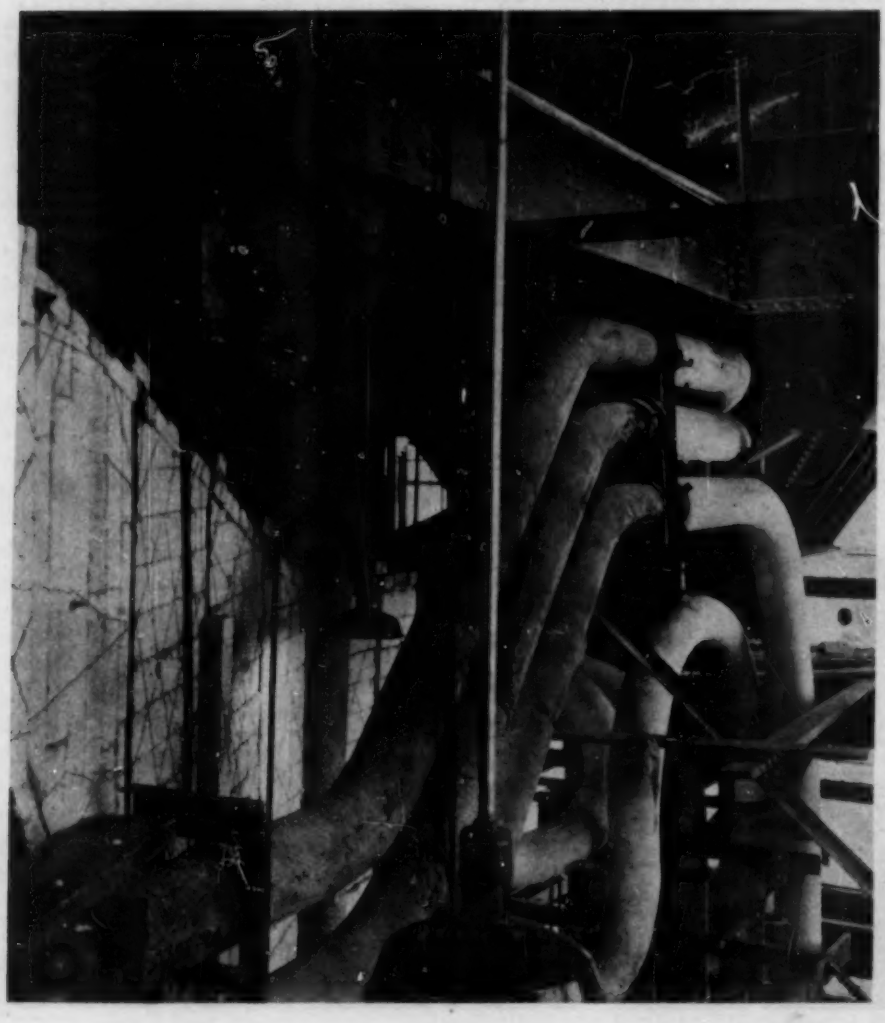


Powdered coal fuel piping used to transport the powdered coal from the pulverizers to burners on the boiler

A SMOKE ELIMINATION Program THAT WORKS

Raymond R. Tucker Tells How St. Louis Enforces Its Rules

ST. LOUIS' SMOKE ordinance was five years old on April 8, 1945. During its life it has been subjected to all manner of attack from various special interests, and in addition it has had to withstand the trying years of the war with its shortage of stoker parts, improperly prepared fuel, and the peculiar psychological attitude that enforcement of the provisions of the ordinance might retard war production. It has emerged from these trials with no apparent physical impairment, and is firmly entrenched in the plans for postwar development of St. Louis.

The enviable position that the ordinance occupies is due to the manner in which it is enforced and the unqualified support it has received from the press, radio, and citizens. This support is of prime importance because the mere passage of an ordinance does not eliminate smoke—it only authorizes some individual, or group of individuals, to eliminate smoke.

If the public demands the passage of a smoke ordinance, the citizens must be made to realize the necessity for their sustained interest in the program. The elimination of smoke in any community is a dual responsibility which should be shared by public officials and citizens alike. Faltering interest upon the part of the citizens may be due in part to a lack of knowledge of the whole subject of smoke elimination. Every means available should be employed to educate and maintain the interest of the public. The press, radio, billboards, personal appearances before fraternal, service, and civic organizations, and the appointment of a citizens' committee are a few examples of measures which may be used to aid in the enlistment of public participation.

Experience will also show that even though the press and radio will generously promulgate information about the aims and objectives of the program, still there will be many who fail either to hear or read the material presented. It becomes necessary, therefore, for the enforcement officer to conduct a continuous educational program. The educational program should include not only explanatory pamphlets for distribution, but innumerable personal appearances before various organizations. The personal appearances enable the people to see their enforcement officer and formulate their opinion as to his ability and integrity. This is essential because, unfortunately, public office-holders are looked upon by many with suspicion until they have proved their worth. Recognition of this condition makes it imperative that every effort be made to establish in the minds of the public and the press the fact that the enforcement officer is sincere, that no political favors will be granted, and the enforcement will be impartial and vigorous. This state of mind on the part of the public can be developed, and—when achieved—the cooperation sought is automatically forthcoming, even from those who have openly opposed the program.

This peculiar quirk of thinking upon the part of the public can be offset partially by the appointment of a citizens' committee to work with the smoke commissioner. The committee can make statements and contacts for the commissioner. The same statements, if issued by the commissioner, would be viewed with doubt instead of being accepted at their face value. Furthermore, the committee is of value in contacting the press, for the attitude of the press toward a citizens' committee is a more benign one than its attitude toward any public official. The citizens' committee is of further value in enlisting support for the enforcement officer during those periods when he is being attacked and his judgment assailed.

It may appear that an undue amount of space has been given to the question of public interest and support, but this is as important as the actual details of enforcement. Efficient enforcement cannot be had without this public interest and support.

Enforcement of the St. Louis smoke program was divided into four separate and distinct categories; each is of equal importance. The methods employed to enforce these various aspects must not be haphazard. They must be logical, efficient, and persistent. These categories are:

1) The routine of the office.
2) The field work of the inspectors.
3) The enforcement of the solid fuel ordinance.
4) The railroads.

In the office are the commissioner, the deputy commissioner, and the chief inspector, besides the nec-

PREPARATION and passage of the necessary ordinances for a smoke elimination program must be followed by proper methods of enforcement, organization of the enforcing agency, public support of the smoke authorities, and unremitting efforts of all kinds to reach the desired objectives. . . . Professor Tucker is well qualified to write on smoke elimination, for he has been intimately concerned with the program in St. Louis. Now head of the department of mechanical engineering at Washington University in that city, he was smoke commissioner of St. Louis from 1937 to 1942. In addition to many talks on smoke elimination before various groups in St. Louis, he has also discussed the program at engineering meetings in cities where it is hoped to inaugurate similar projects. . . . Previous articles of this series were published in the September, the October-November, and the December issues of Heating, Piping & Air Conditioning

essary clerical help. The plan of organization is such that the commissioner of smoke regulation has reporting to him his deputy and the office manager; reporting to the deputy is the chief inspector, and reporting to the chief inspector are the field inspectors.

The commissioner of smoke regulation, in consultation with the other men in the department, formulates policies and adjusts any differences of opinion which may occur between the general public and the enforcement officers. The commissioner also assumes responsibility for all codes and sources of fuel supply. He also initiates and supervises all educational and publicity programs. He is the liaison officer between the department and the administration and the general public.

The deputy commissioner is held responsible for all applications for the installation of fuel burning equipment and the approval of all certificates of operation. Furthermore, he interviews violators, but does not render consulting service (the employment of a consultant is recommended if such service is needed). The deputy is next in line in authority to the commissioner, although the work assigned to him is more specific in character.

All applications for permits and all completed inspections are handled by the chief inspector. It is his duty to check these reports, and if they conform to the existing regulations he indicates his approval. All those which do not require special handling are passed on to the office manager, while those requiring special attention are withheld and submitted to the deputy commissioner for a ruling. The deputy commissioner—in consultation with the commissioner—revises these and indicates the necessary changes required for approval. These are then sent to the office manager for issuance of the necessary permit or certificate.

To expedite the handling of these permits, one inspector is retained on the floor each day to assist the general public in filling out applications and to educate the applicants in the proper method of sizing equipment. He does the preliminary work and the chief inspector and deputy check it.

Issuing Permits and Certificates

Under the jurisdiction of the office manager is placed the issuance of all installation permits and certificates of operation after they have been approved by the deputy commissioner or chief inspector. Furthermore, it is his duty to issue, after investigation, all solid fuel permits to fuel dealers and coal peddlers. In addition he accumulates statistical data which can be used either in publicity campaigns or, if necessary, in the prosecution of individual violators. He is also responsible for all collections of money. He is the smoke department's representative in the courts, and handles, with the city counsellor, the prosecution of various cases which are brought to court. No suits, however, are filed without the approval of the commissioner.

The office personnel must be free of all political influence and pressure. Their character and ability are of grave importance. They must be courteous, they must be alert, and they must be efficient. These qualifications are essential because those calling at the office of the division of smoke regulation are usually irritated and upset. Their call is not a voluntary one, but is generally made under duress. The office should be so organized that no caller is subjected to any minor irritation.

It is the policy of the office to have an information clerk whose duties also embrace stenographic work. Anyone calling at the office is immediately approached, asked the nature of his call, and whom he desires to see. If it is in regard to a specific complaint, the file room is contacted, the file brought to the information clerk, and she in turn presents the caller to the individual to whom he desires to talk, introducing him by name. This courteous treatment often results in a change of attitude on the part of the individual caller.

Comprehensive Filing System

A comprehensive filing system is necessary to make it possible to handle the general public in this manner. Cases are not filed under the owner's name, but under the address, because it is quite possible for the ownership to change. A cross file, however, gives the name of the owner or agent if desired. Each file is complete in itself. Copies of all correspondence, permits, and smoke violations are in the file according to date of issuance so that when a file is handed to either the chief inspector or to the deputy commissioner, a complete record of the case is before him. Any decision he makes after discussion with the individual is typed in the form of a memorandum, signed by him, and attached to the file.

The city of St. Louis is divided into 10 separate and distinct districts, and an inspector is assigned to each of these districts with one man specifically assigned to the railroads and one to fuel inspection. Each man is equipped with a camera, as it has been found that pictures are very beneficial in the

prosecution of cases. It was also found that managements in many cases could be convinced of the severity of their violations when shown pictures of their stacks.

Handling Smoke Violations

Inspectors are required to make all necessary investigation in their district; this includes checking all new and remodeled installations as well as obtaining smoke observations. It is also their duty to check the fuel being delivered in their districts and obtain information on any violations of this particular ordinance. Periodically—that is, every 60 or 90 days—inspectors are rotated; at no time do we want the inspector to become intimate with the fuel users in his district.

Every day each inspector presents a list of smoke violations on form No. 1 (reproduced herewith); a stenographer trained in such work fills out form No. 2 in duplicate and mails one copy immediately to the person responsible for the operation of the fuel burning equipment. The duplicate is sent to the file room and attached to the proper file. As soon as three such violations have been recorded, the file is withdrawn and placed on the deputy smoke commissioner's desk for review and specific action. The case is then discussed by the deputy with the inspector (or inspectors) and the mode of action determined.

If the case is unusual in character, the type of action to be taken is discussed with the commissioner. No case is allowed to die; either specific action is taken by the owner or agent, or prosecution is the immediate result. If specific action is required, the owner is permitted a reasonable time, say a week or 10 days, to show evidence of his good faith, and at the end of that time prosecution is instituted if such evidence of good faith is not forthcoming. Whenever a case is to be prosecuted, the file is turned over to the office manager and he in turn submits the data contained therein to the city counsellor's office for further action.

The successful prosecution of a case does not remove it from the active files, as the smoke authorities are not interested in collecting fines but in eliminating smoke. In many cases the owner is placed on probation because this was found more effective than the payment of a fine. One case in particular demonstrated this fact. There was an installation of a stoker that smoked every morning due to the careless habits of those in attendance. This case was taken to court and a $700 fine was assessed against the manager for seven individual violations. It was recommended he be placed on probation for a period of one year and the fine stayed. For that one year his plant did not violate. Shortly after his probation expired, the plant again became a violator. There is no doubt that the manager

CITY OF ST. LOUIS DIVISION OF SMOKE REGULATION DEPARTMENT OF PUBLIC SAFETY

ADDRESS 4342 McPherson ZONE DATE 11/23/45 INSPECTOR John Smith

NAME John Doe KIND OF BLDG. 6-Family Apartment MIN. VIOLATION

SEND NOTICE TO MIN. OBSERVATION

OBSERVATION POINT

STACK

BOILER FUEL

USED FOR

STOKER OR BURNER

WATER HEATER FUEL

WEATHER WIND

OBSERVATION BEGAN M ENDED M

REMARKS

	0	15	30	45		0	15	30	45		0	15	30	45
0					20					40				
1					21					41				
2					22					42				
3					23					43				
4					24					44				
5					25					45				
6					26					46				
7					27					47				
8					28					48				
9					29					49				
10					30					50				
11					31					51				
12					32					52				
13					33					53				
14					34					54				
15					35					55				
16					36					56				
17					37					57				
18					38					58				
19					39					59				

FORM 171-ML

Every day each smoke inspector makes up a list of smoke violations on this form, referred to in the text as form No. 1

CITY OF ST. LOUIS DEPT. OF PUBLIC SAFETY

DIVISION OF SMOKE REGULATION

NOTICE OF SMOKE VIOLATION

Mr. John Doe
4342 McPherson Ave.
St. Louis, Mo.

On Nov. 23 your stack at 4342 McPherson Ave.
was observed emitting dense smoke in violation of Ordinance 41804 for
minutes, between 10 A.M. and 11 A.M.

It is YOUR responsibility to determine why this equipment is smoking and have the fault corrected regardless of whether the plant is hand-fired or has a mechanical fuel burning device.

Submit to the Division of Smoke Regulation, 419 City Hall (3), within TEN DAYS from this date, a written report of what steps have been taken to put this plant in such condition that it will be smokelessly operated in the future.

J. H. CARTER
Commissioner of Smoke Regulation

IMPORTANT — READ BACK OF THIS NOTICE

From the form filled out by the smoke inspector, a stenographer types up duplicate copies of this form No. 2, one of which is sent immediately to the person responsible for the operation of the fuel burning equipment, the other being retained in the files

for that period of one year closely supervised the operation of the boiler room. He saw $700 every time he looked at the stack. At the expiration of his probation his interest waned, and smoke resulted.

As stated, the smoke authorities are not interested in collecting fines but in correcting conditions, and the mere payment of a fine does not absolve the owner from future prosecution. The purpose of prosecution is to force the owner to eliminate the nuisance, either by installation of new equipment, repair of old equipment, changing fuel, or establishment of a routine which will accomplish the results.

Enforcing the Fuel Ordinance

The third phase of the enforcement program is that involving the solid fuel ordinance. A list of acceptable sources of fuel supply was published to aid the dealers in complying with this ordinance. All the mines permitted to ship fuel into the city were on this list, and each mine was assigned a number. The fuel dealers were issued solid fuel permits, each permit being numbered.

St. Louis—like many other cities—has a weights and measures ordinance that requires that all fuel be weighed on scales by weighers bonded to the city. The division of smoke regulation had the weights and measures ordinance amended so that the weight ticket issued by the bonded weigher is required to show the mine number of the coal being weighed as well as the solid fuel permit number of the dealer who is having the coal weighed. A duplicate copy of this weight ticket is sent to the commissioner of weights and measures office, and these weight tickets in turn are forwarded to the office of the commissioner of smoke regulation. These tickets are checked and any error in the solid fuel permit number or mine number is noted and the dealer asked for an explanation. The information contained on these tickets not only gives the source of solid fuel and the solid fuel permit number of the dealer, but also the address to which the coal has been delivered. If the dealer's explanation is not satisfactory, an inspector is sent to the address to pick up a sample of the fuel, which is subsequently analyzed. This method of checking soon taught the dealers that it was more embarrassing to avoid adherence to the ordinance than it was to follow its provisions. The penalty for violation of any law pertaining to the handling of solid fuel is cancellation of the dealer's permit for one year. One such permit was cancelled because of short weight.

During the early days of the fuel ordinance, many attempts were made by some small dealers and coal peddlers to bootleg unsatisfactory coal into the city. These attempts were usually made during the early hours of the morning or late at night. The illegal coal was trucked in and came over one of the bridges across the Mississippi river. Inspectors were frequently placed at these bridges during the night and coal trucks were checked and followed to their destinations. One such violator used a bakery truck which was painted white. Another means used to apprehend these violators was to have the inspectors report at 5:00 a.m. at the police stations in those districts where we were convinced illegal coal was being used. They would be assigned to a squad car by the captain of the district and then cruise the district with the police. Quite a few basket peddlers were caught by this method.

Working With the Railroads

The source of smoke in St. Louis may be divided into three separate classifications: domestic, commercial, and industrial. Enforcement of the provisions of the ordinance against the stationary plants has been briefly outlined in the preceding paragraphs. The industrial source of smoke might be subdivided into an additional classification—the railroads.

They are not exempt from the provisions of the ordinance, and the specific requirements for the railroads are the use of a smokeless solid fuel, oil, diesels, or

electric engines or locomotives equipped with mechanical devices as defined by the ordinance. Road engines, on the other hand, are not subject to these conditions provided they are serviced in roundhouses so equipped as to enable them to comply with the other provisions of this ordinance regarding the emission of dense smoke.

As the result of the enforcement of the ordinance, the railroads in and around St. Louis have purchased well over 100 diesel engines, and it appears that the switching service will very shortly be handled entirely by diesels. The purchase of these engines naturally made a marked reduction in the amount of smoke being discharged.

The road engines, as indicated in the requirements of the ordinance, require special handling. The inspector assigned to the railroads is a former locomotive engineer, and has also been employed on the installation of stokers on engines. He is capable, and respected by the railroad men. He developed a method of starting fires in road engines which enable them to leave the roundhouse, go to the station, pick up the train, and leave St. Louis before it is necessary to refuel the engine.

The railroads have cooperated to the fullest extent, with one exception. The railroad in question was one of the worst violators, and if possible, was rapidly becoming worse. From conversation with the personnel of this road the impression was gained that no effort was being made because it was their belief that the executive staff of the road had no interest in the elimination of smoke. Inspectors were called into the office and told to obtain pictures of these violations as well as observations. Seventy-eight pictures were obtained. With these pictures in the commissioner's possession, an appointment was made to see the president of this particular road, The period of discussion of the smoke problem was very brief. The commissioner merely walked into the office of the president of the railroad, explained the purpose of his visit, and then like a deck of cards, spread the 78 pictures before him. He was anxious to know the reason these conditions existed and was told that the impression seemed to be prevalent that he personally was not interested in the program. Information came to the division of smoke regulation to the effect that on the afternoon following this call the responsible persons were called into the president's office and very briefly and succinctly told that the record had to be improved or he would obtain personnel that could improve it. The statement was made very shortly thereafter by one of the railroad men that "many who formerly did not believe in a deity were now singing in the choir." It was apparent this was the case because in a period of several weeks the record of this road was materially improved. This incident is related to illustrate the cooperation that can be obtained from management when management is made aware of the actual conditions. Smoke enforcement officers are apt to waste time with individuals who do not possess the necessary authority to correct the situation.

Monthly meetings were held with the master mechanics and the road firemen of the railroads. At these meetings there was presented a rating of the railroads showing the position they occupied with respect to each other in the discharge of smoke. A competitive spirit was aroused and the volume and density of smoke discharged became progressively less. The smoke units on locomotives were reduced from 3.55 in 1939 to 0.62 in 1944.

Although only one inspector is assigned to the railroads, all inspectors are periodically used to assist in covering the various switching yards at the same time. This procedure eliminates careless handling of the engine when the crew is under the impression that the one inspector is in another part of the city.

While on the subject of meetings, there is another type that

EXCERPTS FROM ORDINANCE 41804

Section 5338: Emission of Dense Smoke. The emission of dense smoke within the city from the smoke stack of any boat, tug, roller, derrick, pile driver, tar kettle or other similar machine or contrivance, or from any open fire, or from the smoke stack or chimney of any building, roundhouse or premises, except for a period of or periods aggregating nine minutes or less of a density of No. 2 smoke as defined by the Ringelmann Chart, or six minutes or less of a density in excess of No. 2 smoke as defined by the Ringelmann Chart in any one hour at a time when the firebox is being cleaned out or a new fire being built therein, or from the stack of any locomotive for a period in excess of one continuous minute after said locomotive is in or ready for service, is prohibited and is hereby declared to be a nuisance and may be summarily abated by the Commissioner of Smoke Regulation or by anyone whom he may duly authorize for such purpose.

Section 5349: Boilers or Other Heating Apparatus to be Sealed. When. After any owner, agent, occupant, manager or lessee of any premises who has been previously notified of three or more violations of this Article within any consecutive 12-month period, either before or after its amendment, in respect to the emission of dense smoke, soot, cinders, fly ash or noxious acids, fumes or gases, the owner or agent of said premises shall be notified to show cause before the Commissioner of Smoke Regulation on a day certain, not less than 10 days from the date of notice, why the equipment causing such violations should not be sealed. The notice herein provided for may be given by mail directed to the last known address of the party to be notified, or if said party or his whereabouts is unknown, then by posting a notice on or near the premises at which the violations shall have occurred. Upon said date said owner or agent may appear and be heard. Upon such hearing, if the Commissioner finds that adequate corrective means and methods have not been employed to correct the cause of such condition, then it shall be his duty to seal said equipment until such time as a permit and certificate as herein provided have been applied for and issued for said plant.

Section 5351: Penalty. Any person who shall violate any of the provisions of this ordinance shall be fined not less than Twenty-five Dollars nor more than One Hundred Dollars for each offense, and each day of such violation shall constitute a separate offense.

These excerpts from the ordinance are printed on the back of the "notice of smoke violation" which is sent to those responsible for operation of fuel burning equipment which has been reported as violating by an inspector

has produced excellent results. Each Saturday morning, the division of smoke regulation holds a meeting for the inspectors. The commissioner and his assistants comment (in open meeting) upon the work each inspector has done during the previous week. After the inspectors have been told their shortcomings, an opportunity is offered them to criticise the work of the commissioner, deputy, chief inspector, and office manager. Many excellent suggestions have been obtained from these meetings, and the office routine has been changed in many cases to meet the needs of the inspectors.

A portion of such a meeting is devoted to outlining to the inspectors the aims and objectives of the division as well as informing them as to the status of any court cases that have not been disposed of. If any public statements are to be made, they are read to the inspectors and criticism requested. From this group has been obtained the public reaction to the methods being employed. It is the theory of the division of smoke regulation that an inspector thoroughly familiar with the policy of the department will be more valuable than those who are not fully informed.

One of the most difficult provisions of the smoke ordinance to enforce is the section pertaining to the discharge of fly ash, which presents difficulties because of the involved procedure necessary to prove a violation. The ordinance is specific as to the method to be used.

One plant in particular disclaimed any responsibility on the grounds that the stack was of peculiar design. It was said that it originally had been designed for the burning of wood and the diameter of the stack was such that the velocity of the gases was extremely low. Because of this low velocity it was claimed that the major portion of the fly ash was deposited in the base of the stack. To substantiate the statement, the plant had what was known as an ash balance run on the equipment, which indicated that the grain loading at the stack was below that provided by the ordinance.

The division of smoke regulation, however, assumed the position that the plant was a nuisance and was compelled to substantiate this viewpoint. The stack was taken as a focal point and sampling jars were placed around the circumference of concentric circles of increasing radius. These jars were permitted to remain for a period of 10 days and the collection of dust during that period was then analyzed by the industrial hygiene department of the city. The analysis showed that well over 80 per cent of the dust collected was characteristic of a pulverized fuel plant. It also showed that as the distance of the sampling jars from the stack increased, the size of the particles decreased. The owners, however, contended that they were not the source of this nuisance, and in this interview they stated it was their intent to close the plant for a short period in order to make necessary repairs. After waiting approximately 48 hours after the shut down, sampling jars were again placed in identical positions with the stack as a focal point. After 10 days these collections were again analyzed and it was found that the dust collected was practically negligible. This indicated to the department of smoke regulation that the plant was the source of this nuisance.

To be absolutely sure, we waited until the plant started up again and sampling jars were again placed in the identical positions. After these samples were collected and analyzed it was found that the dust collected again contained well over 80 per cent of the small cenospheres which are characteristic of pulverized fuel burning. This proof was submitted to the management, but they refused to act and suit was filed.

The division of smoke regulation —before filing suit—contacted the company's public relations counsel in the east, its director of public health, and other officials, but no cooperation was had from any of them. Apparently it was company policy to avoid establishing a precedent in any one community because of fear of similar requests in other communities. This experience is contrary to that with the railroads, and was the exception rather than the general rule. As soon as suit was filed, the St. Louis representative of the company requested permission to have a comprehensive test run upon the stack. This permission was granted and the results of this test vindicated the position of the smoke division. Plans for the purchase and installation of the necessary equipment were delayed by the war.

USE THIS ARTICLE in your own community to inform city officials and your fellow-citizens on what can be done, and how it was done in this particular case. Abating smoke—of vital concern and advantage to all—is an engineering job

Sealing Fuel Burning Equipment

One of the most powerful weapons in the enforcement program is the right to seal fuel burning equipment. This right should not be exercised indiscriminately, but only as a last resource if no action can be had in any other manner. This was especially true in the early stages of the enforcement of the law but as the program progressed the need of this authority became less acute. The sealing provision was used effectively against apartment houses, which were a prolific source of smoke. In many cases this was due to incompetent help or to equipment that sadly needed repair. It was also apparently the policy of the owners and agents of these buildings to buy the cheapest type of fuel available to burn in their stokers. This equipment could not be sealed during the winter because it would cause undue hardship to the occupants. At the end of

the heating season, however, this equipment can be sealed and the owner or agent notified that the seal will not be removed unless correction of the condition is made. Such a procedure was used and 100 apartment houses in St. Louis had their heating equipment sealed during the early part of May. Records in the office and the experience of the inspectors in the field in the early part of August indicated that action had not been taken on the majority of these cases. A letter was then written to the owner or agent, calling his attention to the fact that these boilers were sealed, that the seal would not be removed, and if correction was not made by the first of September the occupants of the apartment were to be notified that no heat would be in the apartment during the next heating season. The response to this letter was immediate. It was only in these extreme cases that the sealing provision was used.

The "Surrounding Community" Excuse

The argument is commonly presented that nothing should be done about smoke abatement because the surrounding communities are not taking similar steps. This is a fallacious argument because a large urban community should take the initiative in matters of this kind. Furthermore, no community has the right to point the finger of scorn at another until it has cleaned its own house. The "surrounding community" argument was used by opponents of the smoke ordinance in St. Louis, and was ignored.

After the passage of the present ordinance, the citizens' committee and the commissioner contacted the mayors of the communities surrounding St. Louis. These communities—almost without exception—adopted the same program as had St. Louis. One outstanding exception, however, has not attempted to this date to correct a condition which materially contributes to the smoke in the city of St. Louis. It is only a question of time before this community, too, will establish a program and the results of the St. Louis program will be more noticeable when this occurs.

Results of St. Louis Program

That immediate results of the St. Louis program were obtained cannot be questioned, as this is attested by the following record of total smoke which is kept by the division of smoke regulation:

	Days	Total Smoke* Hours	Reduction
1939-40 ..	82	716:30	.....
1940-41 ..	46	197:15	72.5%
1941-42 ..	47	184:05	74.3%
1942-43 ..	39	142:00	80.2%
1943-44 ..	69	251:10	65.0%
1944-45 ..	46	189:58	73.5%

Besides reduction in the number of hours of dense smoke, there was an increase in the number of hours of sunlight over that of previous years. Records kept by the Missouri botanical garden indicate that in previous years there was a discrepancy of 150 hr of sunlight between St. Louis and the arboretum, which is situated 25 miles out of town. But in the winter following the passage of the smoke ordinance, the records show only 23 more hours at the arboretum than in town. This slight difference could be expected to occur because of local thunderstorms.

The results of the St. Louis smoke program have attracted almost worldwide attention. Inquiries on its details have been received from 221 cities in 39 states of this country, with 13 from Canada, three from England, and two from South America.

*These observations were made in the downtown district, which is immediately adjacent to East St. Louis on the east and the Mill Creek valley, where all the railroads pass through, on the south.

IBR ANNOUNCES NEW HEATING GUIDES

FOLLOWING enthusiastic reception accorded its installation guide No. 1, members of the Institute of Boiler and Radiator Manufacturers at their annual meeting authorized the publication of two new guides and approved the general outline of two additional guides. Thus, a total of five have been published or approved. No. 1 describes the method for designing and installing a one pipe forced circulation hot water heating system. No. 2 will offer suggestions on the installation of a one pipe steam system, while No. 3 will cover the selection and installation of water heaters. The printing of Nos. 2 and 3 will be completed about March 1. Nos. 4 and 5 will provide data on the installation of a two pipe reverse return gravity hot water system and radiant heating.

Material in all guides is based on the IBR research program at the University of Illinois which is now in its fifth year. A. E. Bastedo, vice-president of the Burnham Boiler Co., chairman of the IBR, presided at the convention and was re-elected chairman.

During the two-day session, the members of the institute authorized a survey of the heating preferences of builders and architects, discussed the allowance for the domestic hot water load in the selection of heating boilers, decided on the extension of the IBR rating code to boilers of all sizes, voted to proceed with plans for standardization and simplification of hot water supply boilers, tank heaters, and convectors, and agreed in principle on methods for testing radiant baseboards.

One of the most important subjects discussed was a plan for the development of 65 standard stock assemblies of radiators. It is believed that the proposed program of standard assemblies of radiators will meet the requirements of most jobs. Many wholesalers have expressed their approval of the plan, pointing out that it will permit them to maintain more adequate stocks of radiation than they had during the prewar years and thus should aid greatly in a more rapid turnover of radiator inventories.

"Open for Discussion"

WHEN ENGINEERS gather to hear a paper or talk, there comes a time when the meeting is thrown "open for discussion." We follow this custom in these columns, which provide an opportunity for readers to comment on articles published in HPAC; discuss other topics of interest to heating, piping, and air conditioning engineers and contractors; ask questions, etc.

METHODS OF FILING ENGINEERING DATA

THE EDITOR—I was interested in the article on page 621 of the December HPAC entitled Methods of Filing Engineering Data. In my office at the present time there is 19 ft of shelving filled with equipment catalogs, and any particular one can be found in a few seconds, so I thought you would be interested in the method adopted.

On starting the system obtain a supply of ordinary 5x3 in. filing cards, a set of alphabet tabs, and a box to hold them. On the "A" index tab write the numbers 1-49, on the "B" tab the numbers 50-99, and so on through the alphabet. Sort the catalogs according to subject—Air Compressors, Air Filters, Ash Hoists, etc.—and call that the "A" pile. Then, Boilers, Blast Coils, Belts, etc., would go into the "B" pile, and so on, continuing through the list.

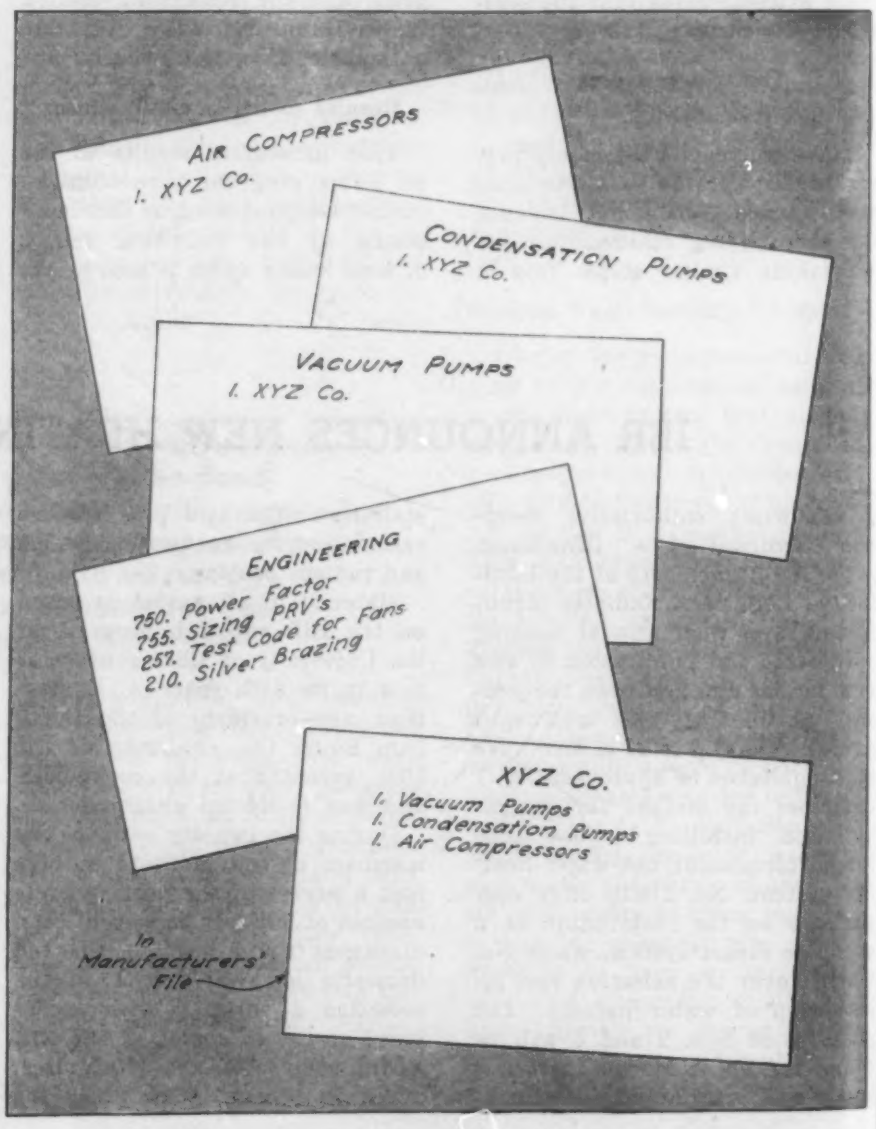
Now we can start to catalog by taking the first book, which we see is Air Compressors manufactured by the XYZ Co., and mark the figure 1 on the top left hand corner of the front cover. A file card is headed AIR COMPRESSORS, and we write "1. XYZ Co." under it. The next book may be on Air Filters made by the UVW Co., and this is marked 2 and a card is headed AIR FILTERS and under it is written "2. UVW Co." Continue through the A's until that pile is exhausted.

The B's are started in the same manner, except the first book is numbered 50, the first under C is numbered 100, and so on. This method is very flexible, as there is always room for catalogs that arrive from time to time after the system is started. I have found it unnecessary (or, rather, impractical) to attempt to keep all catalogs on the same subject together, although that could be done by using the decimal system.

Before putting the Air Compressor catalog No. 1 on the shelf, we look through it and find that there are also Condensation Pumps and Vacuum Pumps made by the XYZ Co., so we head cards with these descriptions and under the headings write "1. XYZ Co."

Many catalogs contain a great deal of valuable information to which it is necessary to refer at various times. In my file I have a card headed ENGINEERING and on it is listed the catalog numbers and the subject of the information contained in that particular book. Typical subjects are Power Factor, Sizing Pressure Reducing Valves, Test Code for Fans, Silver Brazing, etc.

A valuable adjunct to my filing system is the Manufacturers' File. This is a separate filing box, with cards and alphabet tabs, and the cards are headed with the name of the manufacturer with the catalog number and the type of equipment written below.—A. E. KNIBB, L. L. McConachie Co.



Mr. Knibb uses file cards such as these to index the catalog data in his office

CONTROL OF UNIT VENTILATORS IN SCHOOLROOMS

THE EDITOR—In a recent paper on the heating and ventilating of school buildings, the control of unit ventilators by automatic means was discussed. This problem (especially control of the outlet air temperature) has concerned me too, and I have done considerable work on it in connection with several school houses using conventional types of unit ventilator and other equipment, but operating the systems on the subatmospheric principle of steam circulation. This of course involved the use of central control equipment for controlling the subatmospheric pressures.

The fundamental consideration is that a variable performance of the unit ventilator is needed to meet the varying requirement for heat, yet ordinarily the unit is supplied with an inflexible (or practically so) heating medium (steam at about 1 psi pressure, or 215 F). Such a medium, while necessary at design temperature (unless 100 per cent recirculation is permitted at that time), is completely unnecessary at any other outdoor temperature—in fact, not only unnecessary but undesirable. To compensate for this lack of flexibility, means must be provided to shut off or at least throttle the steam. This immediately requires another control, the ductstat, to prevent too great a drop in air temperature during the off period.

Subatmospheric Steam

To simplify all this, I used subatmospheric steam capable of being circulated at a variable vacuum. Immediately I was able to omit both the steam valve and the ductstat. In addition, I found I could throw out the steam control valve on the auxiliary radiator in the same room with the unit ventilator and use in its place a fixed orifice (no orifice was used in the radiator of the unit ventilator). In fact, the only room control I used was a thermostat operating on the outdoor air damper and even that device can be omitted on some installations.

Without going into the technical details any further, the pleasing result was better heating with less equipment and that is a most desirable result in these days of complications in heating system control.

The requirements for outdoor air to be taken into occupied classrooms in many states are needless to the point of being actually detrimental rather than beneficial.—LEWIS SMITH.

GERMANS DEVELOP AIR PURIFICATION DEVICES

Developmental work by the Draegerwork, Luebeck, Germany, on air purification devices for underwater craft and high altitude demand regulators for aircraft is reported by allied investigators as being among the most important of the firm's many wartime projects, the Office of the Publication Board, U. S. Department of Commerce, said last month. The findings of the investigators are presented in report No. 380, entitled "Draegerwork, Luebeck, Germany" (photostated, 55 pages). The report is obtainable from OPB at $4.00 per copy.

The Draegerwork, well known for its production of precision instruments, was concerned with high altitude oxygen breathing apparatus; submarine escape apparatus; diving apparatus; gas masks; oxygen cutting and welding apparatus; mine safety apparatus; rubber, surgical, and technical goods; air conditioning apparatus; swimming vests for pilots, and related subjects. These are discussed in the report. The report also contains information concerning the company's developmental work on parachute emergency oxygen apparatus; high altitude demand regulators; combination oxygen indicator and pressure gage; pressure suits; air purification systems; and anesthesia and inhalation apparatus.

According to the report, high altitude demand regulators, used in aviation, were constructed only for pursuit aircraft. The operating characteristics of this regulator are described briefly in the report. The investigators state that their accuracy remains to be verified.

Reducing regulators, made by the Draegerwork, also are discussed in the report. They were designed and built for such purposes as catapult seats, underwater diesel motors, shallow swimming and diving suits, and torpedo ejection.

Air purification devices developed at the Draegerwork for use in submarines, especially in the one and two-man U-boats, appear to be well ahead of western allied developments. Necessity for air purification in these craft entailed design and development of a less bulky purification system than that incorporating a fan and motor. This was particularly essential in craft designed on the torpedo principle. The system was later used also in midget submarines. A description of this system is presented in the report.

Report 380 may be purchased in Room 2065, Commerce Building, or ordered by mail. Mail orders should be accompanied by check or money order, made payable to the Treasurer of the United States, and should be addressed to the Office of the Publication Board, Department of Commerce, Washington 25, D. C.

ESTIMATES '46 CONSTRUCTION 50 PER CENT OVER '45

Even in the face of retarding factors, F. W. Dodge Corp. estimates total dollar volume of new construction in 1946 as 50 per cent greater than in 1945 in the 37 states east of the Rocky Mountains. The estimate for all construction in the 37 eastern states is $4,750,000,000.

"In dollars, this volume is greater than that of any of the years immediately preceding the war," a statement issued by the corporation declares. "Taking cost increases into account, it represents a physical volume somewhere between that of 1939 and 1940. The percentage increase is about as high as the highest ever previously attained from one calendar year to the next," the overall Dodge estimate indicates.

Nonresidential Construction

The corporation anticipates an increase of 20 per cent over 1945 in nonresidential construction, with substantial increases in public and religious buildings in this classification. An increase of 178 per cent in residential construction, with a total of $1,350,000,000 in the eastern states, is estimated. One- and two-family house construction will dominate residential building in 1946, the report states.

Sam Lewis' Page

IN THIS regular feature, informal comment on heating, piping, and air conditioning matters is given by Samuel R. Lewis, consulting mechanical engineer, and a member of HPAC's board of consulting and contributing editors

HEATING AND COOLING CHURCHES

THERE IS MUCH talk about new houses of worship that are to be built as soon as the competition for materials and labor devoted to other purposes eases up.

I have participated in the construction and reconstruction of a great many churches, the country over, including buildings occupied by many different denominations. It has been my experience that large auditoriums generally are not particularly difficult to heat with mechanically-delivered air. There are very large windows in most churches, frequently of stained glass set in lead, and almost invariably these windows leak, so that people sitting near them feel cool air drafts. The best answer I have found to this trouble is to provide heat transmission below the windows; this can be done with radiators or by blowing warm air upward through slots in the window stools.

If, as frequently happens, there is a balcony opposite the pulpit with a large stained glass window behind the balcony, one may be confident of cool air falling over the balcony rail and bringing forth protests from the main floor pew holders who receive these cool air currents on their heads.

If there is, as in many gothic churches, a clerestory, the windows up there are inclined to cause falling air currents, if indeed they do not cause falling water. This falling water may be due to blown-in rain or snow, but is more likely to be the result of moisture from the bodies of the audience, that condenses and freezes on the cool glass, eventually to be melted when the glass surfaces are warmed.

Due to the intermittent occupancy of most church assembly rooms, the interior temperature is allowed to fall many degrees below that in effect during normal services. Since this intermittent heating is common, the wise designer of church heating systems provides extra capacity all the way back to the fuel pile.

Many churches are of the institutional type, where some of the activities are carried on daily and even nightly, but usually the main auditorium need be brought to full temperature and need receive ventilation only during a few hours each week.

For this reason steam heating, with mechanical ventilation, is found in most modern *institutional* churches, with valves and dampers and other facilities to encourage separation. There are a few large churches heated by mechanically circulated hot water; this seems to be especially favorable for Catholic churches that are kept comfortable continuously. Many churches have automatic temperature control arrangements that bring about a controlled reduced temperature at night or during recesses, either by manual intervention or by a clock.

Warm air furnaces, direct fired and having pressure fans that force the air around the heating surfaces and then onward into the auditorium, are in successful operation in many churches.

Prior to 1940 there were frequent applications for estimates of cost for installing refrigerated cooling for churches. Almost invariably these projects were abandoned when the cost of such cooling was disclosed. The public has plenty of money to cool picture theaters where terms of incarceration may be extended, but it seems to feel that the term of occupancy in a too-warm church can easily be self-limited. There is of course difficulty in making the arithmetic show cause, cost-wise, for installation of summer cooling for churches.

In designing refrigerated cooling for churches there is a justifiable opportunity to use a relatively small condensing plant with storage of chilled water or of ice against the peak load, thus reducing the operating and investment costs.

One must beware especially of the danger of noise and vibration from mechanical equipment bothering the preacher or the audience. In one case I placed the fans at the end of the church most remote from the pulpit, but unfortunately the boilers were under the business end and the dominie was upset every time the sexton poked up the fire. In some modern churches the whole structure seems to transmit and amplify noise and great attention must be paid to use of absorbent areas around the machinery and inside the air ducts.

Never Strike a Lady from Behind

Perhaps—during the recently deplored church building vacation—I have forgotten how to heat a church, but the following axioms are green in my memory.

1) Make the air movement meet the people in their faces, and never strike a lady or a man from behind.

2) Use heat transmitters of temperate intensity—large, warm surfaces; large, low velocity ducts and grilles.

3) Protect the worshippers from cool downdrafts such as come from large windows and poorly insulated walls.

4) Install two boilers of equal size rather than one large boiler and one small boiler, thus giving opportunity to employ either for any department during mild weather.

5) Excommunicate the salesman for automatic firing equipment who tries to sell a stoker or oil burner for but one boiler when there are two that should be so equipped.

6) Also separate from the fold the designing engineer who fails to provide adequate noise absorbing for fans, motors, pumps, etc.

...on Operation, Maintenance, Repair, Alteration, Extension

You are invited to contribute a "practical pointer" on operation, maintenance, repair, alteration, or extension of a heating, piping, or air conditioning system serving a plant or large building, for publication here. Address The Editor, Heating, Piping & Air Conditioning, 6 North Michigan Avenue, Chicago 2, Ill.

How Faulty Operating Methods Increase Pollution of City Air

COMMONSENSE IN EVERYDAY OPERATING HABITS CAN REDUCE SOLIDS DISCHARGE FROM STACKS

How to reduce atmospheric pollution was the subject of an article in a recent issue of Scotty-Grams, a publication of the Chicago Board of Education, which is distributed to its operating personnel. The following paragraphs, taken from this article, which was prepared by Frank A. Chambers, in charge of the department of smoke inspection and abatement of the city, are given here through the courtesy of John Howatt, business manager and chief engineer of the Board of Education, and a member of HPAC's board of consulting and contributing editors:

A major portion of the solids contained in city air could be eliminated by the application of commonsense to everyday building operating habits. Listed below are some common errors that many engineers and firemen commit.

1) *Cleaning fly ash accumulation at base of stack by stirring up ash so that it is discharged out of stack.*

This "easy" method of getting rid of fly ash is one of the principal causes of heavy dust fall. *It should not be tolerated.* The proper method is to wet the surface of the ash accumulation at the base of the stack before the cleanout door is opened. A 1 in. hole should be cut in the stack at a level higher than the ash is ever allowed to accumulate. This hole should be kept covered except when water hose is inserted to wet ash. After the ash has been wetted at the base of the stack, the cleanout door can be opened and the ash disposed of in the same manner as is the ash and clinker from the grate.

2) *Cleaning breeching and settling chambers in boiler at irregular and infrequent periods.*

The more fly ash accumulates in a breeching or other space intended for gas passage, the more restricted does the space become, resulting in higher flue gas velocity. High gas velocity prevents ash from settling out of the stream of flue gases. Investigators have reported that after fly ash has accumulated to a certain height in a breeching there is a marked tendency for great quantities to lift up off the accumulation and surge out of the stack. Breechings should be provided with fly ash hoppers so that ash may be removed without possibility of it being stirred into gas stream.

3) *Burning rubbish in base of stack or on grate of unused boiler with damper wide open.*

This practice permits the discharge of large quantities of charred paper into the atmosphere.

4) *Using cleanout door in breeching or at base of stack as a means of securing ventilation in a boiler room.*

This method indicates that the engineer is not thinking or that he is not familiar with the simple rudiments of combustion engineering. An open cleanout door reduces the available draft in the furnace, often causing it to smoke. Moreover, an open cleanout door permits the entry of large volumes of air, increasing the flue gas velocity and thus preventing the deposition of dust. Any opening—such as a barometric draft regulator or cleanout door below the breeching level—prevents that part of the stack from acting as a settling chamber (for which function it was intended). The upward movement of air into this zone, which necessarily should be in a quiescent condition, prevents any settling or accumulation of dust.

5) *Blowing tubes with dampers wide open or at frequent intervals.*

Tests indicate that the discharge of solids while tubes are being blown ranges up to one hundred times the normal discharge. Great care should therefore be exercised when tubes are being blown. The damper should be closed as much

as possible. Tubes should be blown or cleaned as often as is practical. Soot prevents the transmission of heat through the tubes into the water to be heated. The resulting higher stack temperature not only means inefficiency in fuel economy, but also higher discharge of solid matter from the stack due to the increased velocity produced by the fact that gases expand when heated. A water spray in the stack is very helpful in reducing solid discharge when tubes are being blown. There are 25 such installations in Chicago; all are operating satisfactorily without causing damage to the stack.

6) *Operating a steam ash ejector which is directly vented into boiler stack.*

A steam ash ejector directly vented into a boiler stack results in fine ash becoming entrained in the steam and being discharged out of the stack. Settling chamber and/or water sprays should be used to remove dust from steam before system is vented into boiler stack.

7) *Operating just within the law.*

Data secured by a recent air pollution study indicate that the total time plants emit light smoke greatly exceeds the time that these plants emit heavy smoke. Some engineers make little or no attempt to reduce light smoke discharge from their stacks, thinking that their obligation ceases when they live up to the terms of the smoke ordinance. They fail to realize that dirt and grime results from the discharge of light smoke as well as from the discharge of heavy smoke. Nor do they realize that the total dirt discharged into the atmosphere may be much greater when a stack operates with a light continuous smoke than when the same stack is clean most of the time and emits heavy smoke for relatively short periods.

8) *Failure to remove dirt accumulation on roof.*

Heavy winds sweep up dirt accumulation on roofs and spread it. Roofs should be cleaned frequently by wetting dust, which usually accumulates at corners of roof, and disposing of wetted dust with the ash and clinker from the grate.

9) *Delivery of untreated fuel containing fines.*

Fines of such coal are spread over neighborhood when dumped. Heavy winds sweep away considerable amounts of the fines if the coal is allowed to remain in an exposed pile for any length of time.

IMPROVED operation of heating plants doesn't always require investment in new equipment; frequently, it's a matter of better use of the existing equipment and the application of commonsense to daily routine. . . . Here are some operating suggestions, addressed particularly to school engineers but applicable to larger heating plants in all types of buildings, which will aid in preventing the discharge of solids from stacks and thereby will assist in prevention of atmospheric pollution.

Operating Hints for Reducing Air Contamination

Engineers can cooperate in a campaign to rid the city of unnecessary dust and grime by following the simple rules listed below:

1) Operate with stack clean at all times.

2) Operate with minimum overfire draft required to keep stack clean.

3) Do not burn rubbish at base of stack or on grate of unused boiler with damper wide open.

4) Clean base of chimney by wetting fly ash before opening cleanout door and dispose of accumulation in the same manner as clinker and ash is disposed of.

5) Clean breeching and settling chamber at regular and frequent intervals.

6) Clean tubes as often as is practically possible.

7) Never use cleanout doors as means of ventilation.

8) Close damper as much as possible when blowing tubes.

9) Encourage the installation of some means of arresting solid discharge from stack, such as settling chambers, water sprays in stack, mechanical or washer type dust collectors, or screen on top of stack to arrest discharge of charred paper.

10) Clean roof regularly.

11) Store sand and other building materials in enclosed space.

12) Use oil treated or calcium chloride sprayed coal.

13) Encourage scavengers to use covers on trucks to haul ash and rubbish away.

14) Install equipment that will provide more than the minimum requirements of the department of smoke inspection and abatement for smoke, dust, and fume abatement. This should include overfire air, combustion controls, smoke indicators and/or alarms, and high enough stacks to insure that no nuisance occurs to neighborhood buildings.

SIMPLIFIED SOLDER JOINT FITTINGS

Printed copies of simplified practice recommendation R212-45, cast brass, solder joint fittings, are available, according to an announcement of the division of simplified practice of the National Bureau of Standards.

The recommendation sets up a stock list of such fittings "representing the best thought of the industry, its distributors, and customers as to what constitutes desirable practice for the immediate future." Sketches illustrate the 37 types of fittings, various sizes of which are included in the list.

Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for 5 cents each.

HONORED BY REFRIGERATING ENGINEERS

A life membership certificate in the American Society of Refrigerating Engineers was given Dr. Arthur W. Ewell, consultant to the Westinghouse Lamp Div., for "distinguished service" to the society, at the 41st annual meeting of the ASRE. Dr. Ewell, a retired physics professor at Worcester (Mass.) Polytechnic Institute, has been conducting research on the "Sterilamp" ultraviolet lamp, whose invisible rays kill bacteria.

SAVING FUEL IS GOOD BUSINESS

Wartime National Fuel Efficiency Program Closes, But Objectives Are Still of Value

A VALUABLE feature of the wartime National Fuel Efficiency Program was the extensive series of "quiz sheets" containing tips on methods of conserving fuel in the use, operation, maintenance, and repair of various items of piping, heating, and air conditioning equipment. Because fuel conservation—a wartime necessity—is always good business and sound engineering, it is planned to publish in HPAC from time to time the information from these sheets. Suggestions on fighting waste in air conditioning and refrigerating systems, and for exhaust steam utilization, are given on the following pages.

ACTIVE VOLUNTEER work of the National Fuel Efficiency Program, which was conducted in cooperation with the U. S. Bureau of Mines, has been brought to a close, as a result of the findings of the fuel authorities that, with the ending of the war, the fuel situation was no longer serious enough to make it necessary to continue to call on volunteer forces for their help.

This does not, of necessity, mean that there is plenty of fuel now available but rather that fuel conservation is now a peace-time problem, according to Thos. C. Cheasley, supervising engineer, and Kenneth M. Waddell, assistant supervising engineer, of the National Fuel Efficiency Section of the bureau.

Fuel conservation — a wartime necessity—is, however, good business and sound engineering always. It is really cheaper to burn 100 dollar bills than to burn $100 worth of coal or other fuel needlessly. For this reason, the wartime objectives of the National Fuel Efficiency Program should be remembered now, and everyone concerned with the utilization of fuels might well continue to aim at them.

One of the valuable features of the program was the extensive series of "quiz sheets" on fuel efficiency developed in cooperation with various manufacturer groups and distributed by the program's regional engineers to "waste chasers" in individual plants and buildings. Because the information from these sheets is still just as valuable as it was during the war, we plan to print a number of them from time to time in HPAC, with the approval of the National Fuel Efficiency Section of the Bureau of Mines, which is part of the U. S. Department of the Interior.

The first two of these sheets to appear in HPAC were published last month. In this issue appear the sheets on air conditioning and refrigerating losses, both prepared by the Air Conditioning and Refrigerating Machinery Association, and the one on exhaust steam, prepared by the Steam Utilization Equipment Manufacturers Committee. These were Nos. 327, 326, and 303, respectively, in the series.

We are omitting from each of the sheets the final question: "What are your suggestions for saving fuel and preventing waste?" Perhaps this question is the most important of all fuel saving tips, for the operating engineer knows his own plant better than does anyone else, and his "suggestions to himself" for conserving fuel, *if carried out*, often represent the most important fuel conservation opportunities.

Losses in Air Conditioning Systems Affect Fuel & Energy Consumption

1) *How do air conditioning losses affect fuel and energy consumption?*

Poorly designed, improperly installed, and carelessly operated air conditioning systems require excessive amounts of energy and fuel in order to attain desired conditions. Each system should be well designed, properly installed, and carefully operated so that all losses will be minimized, thus conserving fuel and energy.

2) *Is your air distribution system adequately insulated?*

Inspect all insulation on the air distribution system. Damaged, oil soaked, or water soaked insulation should be repaired or replaced at once in order to eliminate losses.

3) *Is the space being conditioned adequately insulated?*

Carefully check the insulation surrounding the space being air conditioned. All cracks and joints should be properly sealed to prevent leakage.

4) *Are your control devices properly adjusted to maintain the desired temperature, humidity, and ventilation?*

Examine all control valves, switches, and operating devices. Place each in proper adjustment so that desired operating conditions may be economically maintained.

5) *Are the fans and ducts of the correct size to supply the required number of air changes per hour?*

Fans and duct systems of improper design may require excessive

power for economical operation. Consult reliable source of information for correct size and be assured of the adequate number of air changes per hour.

6) *Are the air filters cleaned or renewed as often as necessary to maintain clean, free moving air?*

Dirty air filters offer greater resistance to flow and may not adequately clean the air. The former results in excessive fuel and energy consumption, while the latter permits objectionable air to flow. Clean or replace air filters periodically so as to maintain clean, free moving air.

7) *Are all doors, windows and other sources of air leakage kept as tightly closed as possible?*

Air leakage represents directly or indirectly a waste of fuel and energy. Be sure that all doors, windows, ducts, and any other sources of air leakage are properly closed. All cracks and openings should be carefully sealed against leakage. Simple methods and materials may be quickly applied, resulting in substantial savings.

8) *Is all mechanical equipment inspected, cleaned, and lubricated regularly?*

Mechanical equipment renders greatest satisfaction at lowest expenditure of energy when intelligently maintained. Frequent inspections, cleaning, and lubrication pay dividends and should be carried out with great regularity. Thoroughness in this practice is necessary for economies of fuel and energy.

9) *Do you have the manufacturers' operating and service instructions?*

Manufacturers' operating and service manuals are indispensable in a well-planned installation. Manufacturers are eager to render service. Get your service and operating manuals at once.

Refrigerating Losses Affect Fuel or Energy Consumption

1) *How do refrigerating losses affect fuel consumption?*

Faulty refrigerating equipment and installation will require extra energy to produce the desired temperatures.

2) *Is the insulation in good condition and of sufficient thickness?*

Check all insulation of refrigerant or chilled water lines, cold air ducts, refrigerated rooms and boxes, etc. Broken or water soaked insulation should be repaired or replaced. Gaskets on all doors of refrigerated spaces should be tight and in good repair. Refrigerator doors should be kept closed as much as possible.

3) *Are condensing pressures excessively high?*

Operating head pressures for ammonia systems usually average about 150-200 psi and for "Freon" systems 100-150 psi. If pressures become higher than normal, steps should be taken to lower them, as high pressures require excessive power input to accomplish the required cooling duty. High head pressures are usually caused by:

a) Air in the system. In such cases the air should be purged from the receiver and the condenser.

b) Dirty or clogged condenser tubes. The tubes should be cleaned periodically.

c) An insufficient supply of cooling water for the condenser results in excessively high condenser pressure and in turn reduces refrigeration efficiency.

4) *Are compressors in good condition?*

Badly worn or otherwise mechanically faulty compressors and pistons require an excessive amount of power, and frequently do not deliver the rated capacity. Compressors should be checked internally to detect such things as leaking or broken valves, worn piston rings, and scored cylinders. When automatic starting bypass valves are part of the equipment, these should be checked frequently to insure proper operation, otherwise an excessive power intake may be required when starting. They should also be checked against leakage in operation in order to maintain maximum efficiency.

5) *Are refrigerant coils kept properly defrosted?*

Refrigerant coils should be defrosted frequently and regularly. Ice, when allowed to build up on coils, acts as an insulator and cuts down the heat transfer of the coils, thereby requiring excessive power input to accomplish the necessary cooling effect. Check for dirty filters and for too low a cutout or cutin setting of the low pressure switch.

6) *Are all automatic controls properly adjusted?*

High and low pressure cutouts for compressors should be checked by a competent refrigerating serviceman to make certain that the compressors are operating at the proper pressures to prevent short cycling of the equipment, and to prevent operation at suction pressures which are too low. Thermostats should not be set lower than necessary.

7) *Have the cooling coils become flooded with oil?*

In ammonia systems especially, certain types of cooling coils may become partially flooded with oil, thereby reducing their cooling capacity and causing inefficient operation. The coils should be checked periodically for such condition. If oil is present, it should be drained off at the lowest point of the coil or cooler.

8) *Are spray nozzles in cooling towers, cooling ponds, wetting surface refrigeration units, evaporative condensers kept clean?*

When spray nozzles become dirty or clogged, the amount of water or brine sprayed is reduced, thus lowering the efficiency of the equipment and requiring a higher power input to produce the desired conditions. Nozzles should be inspected regularly and kept clean at all times.

9) *Are there leaks in the refrigeration, brine, or water system?*

A periodic check should be made for refrigerant, brine, and chilled water leaks. These should be repaired whenever found, in order to maintain a high efficiency in the plant.

10) *Are there dirty strainers or filters in the system?*

Clogged or dirty brine, water, or refrigerant strainers or filters can easily result in inefficient operation. Such equipment should be regularly checked and cleaned.

Exhaust Steam Utilization

1) *What is exhaust steam?*

Exhaust steam, as referred to in this quiz, is steam which leaves a noncondensing steam engine, pump, etc., through the exhaust connection or outlet.

2) *What is live steam?*

This is the term used in referring to steam as it comes from the boiler or superheater and as it exists in the plant before any of its heat has been extracted for some useful purpose.

3) *How does exhaust steam utilization save fuel?*

Unless used, exhaust steam escapes to the atmosphere and its heat content is lost, whereas in many cases it can be used for purposes which otherwise would require the use of live steam, thereby reducing the amount of live steam which must be generated, and saving fuel.

4) *Is the heat content of exhaust steam enough to justify considerable effort to utilize it?*

Yes. Only a small percentage of the live steam heat content has been removed. For rough estimates of heat lost if exhaust steam is wasted to atmosphere, it may be assumed that the heat content of the exhaust is 90 per cent of that in the live steam. In most plants the percentage will be higher, while in some less than 90 per cent may be present, depending on plant conditions and equipment. Many exhaust steam applications are such that use is made of practically all of this heat.

5) *What properties of exhaust steam are usually of interest in considering how it can be used to the best advantage?*

The temperature—A common use for exhaust steam is in heat exchange equipment, in which case the temperature must be at least slightly higher than that required for the heated substance. The temperature of steam exhausted from a machine is lower than that of the live steam which entered the machine.

The pressure—This has a bearing on the amount of exhaust steam which can be passed through a given pipe size. Since exhaust steam is usually at a low pressure, often near atmospheric, the allowable pressure drop through piping is often small. Also, the amount of power from prime movers using exhaust steam and condensers depends on the exhaust steam pressure.

The specific volume (space occupied by a given weight of steam, expressed as cu ft per lb)—This affects the piping and equipment sizing.

The heat content—This must be considered in estimating how much exhaust steam is required for a certain purpose.

6) *How can the above properties be determined?*

The pressure is known in most plants from gage readings. It is sometimes convenient to measure the temperature, but in most cases exhaust steam is not superheated, and the temperature may be found from steam tables, since for saturated steam there is a fixed relationship between pressure and temperature. The specific volume and heat content are not easily measured, but can be estimated with suitable accuracy by engineers familiar with such problems.

7) *How may the heat in exhaust steam be utilized?*

Some of the uses are:

a) Boiler feedwater heating. This is a common way of using the exhaust steam from boiler or power house auxiliaries such as pumps, fans, and stoker drives even if no other use is made of exhaust steam. Steam at or a few pounds above atmospheric pressure is usually satisfactory for this purpose, and since the feedwater heater and auxiliaries are generally located fairly close together, the piping is not excessive.

b) Service water heating. The usual exhaust steam pressures are satisfactory for this use provided that the heater and piping are suitably sized.

c) Space heating. Exhaust steam is used for this purpose when the distribution piping is sized so that the pressure drop is not excessive.

d) Process heating. There are many processes in industry which can utilize available exhaust steam as a heating medium. For successful use, the exhaust steam temperature must be high enough to give a satisfactory heating rate and to bring the material to the desired temperature. Piping and equipment must be large enough to handle the usual low density steam with a reasonable pressure drop.

e) Power production. In some plants where there are large amounts of exhaust steam, and other conditions are favorable, the installation of a low pressure turbine with condensing equipment may be considered. However, much less of the heat of the exhaust steam is saved by this means than by the other uses noted above.

f) Refrigeration and air conditioning. This use may be given consideration, particularly for plants where the exhaust steam is used for space heating in the winter, and considerable steam is lost to the atmosphere in the summer.

8) *Can additional uses for exhaust steam be created by raising the exhaust pressure?*

In many plants the exhaust pressure carried in the plant may be increased safely and without operating diffi-

culties. In process heating, particularly, the additional temperature of the steam due to increased pressure sometimes is enough to allow the use of exhaust steam which would have been useless for the process at the lower exhaust pressure.

9) *Is the method of exhaust steam utilization in the plant such that the least amount of heat is lost?*

In plants where there is exhaust steam at different pressures, it is sometimes possible to disconnect equipment taking steam from a high pressure exhaust line deficient in exhaust steam and connect the equipment to an exhaust line having an excess of lower pressure steam which will do the work satisfactorily. This will reduce the steam lost from the lower pressure line.

Exhaust steam used in low pressure condensing turbines for the production of power when it could be used for space or water heating, or process work, is not being used to the best advantage, since much heat is lost to condenser circulating water.

The exit temperature of a substance heated by exhaust steam heat exchange equipment in poor condition may be found to be much less than should be obtained. This is particularly true where close control of the temperature is not essential because of further heating later in the process. When live steam or fuel has been used to make up the temperature deficiency, correcting the condition of the equipment will increase exhaust steam utilization, and save fuel. An airbound boiler feedwater heater using exhaust steam at 1 psi gage is an example; the feedwater may be heated to only 150 F instead of about 215 F, and the 65 deg difference is made up in the boiler by burning fuel.

A careful check of the plant arrangement for exhaust steam utilization often will reveal ways in which improvement may be made that will prevent the loss of exhaust steam to the atmosphere.

10) *What should be observed to find out if all exhaust steam is being utilized?*

When there is more exhaust steam available than is being used, the excess is discharged to the atmosphere, usually through a pipe terminating above the building roof. Observation of this pipe where it discharges to the atmosphere shows, if there is no steam flowing, that all exhaust steam is being utilized.

11) *If use cannot be found for all the exhaust steam normally produced, can loss to the atmosphere be prevented?*

It is sometimes possible to reduce the production of exhaust steam enough to prevent loss to atmosphere. Motor driven instead of steam driven auxiliaries may be used in the power plant. The amount of exhaust steam produced may be minimized by maintaining the steam driven auxiliaries and noncondensing prime movers in good repair.

12) *What controls are used in an exhaust steam system?*

The exhaust steam system is usually a closed system which consists essentially of the machines that produce the exhaust, the equipment that uses it, and the connecting piping. If the production and use (plus radiation and leakage losses) of exhaust steam were always exactly equal, no controls would be necessary, but any unbalance causes a pressure change in the system. This pressure change must be controlled within reasonable limits which depend on the machines and equipment connected to the system.

Automatic controls for this purpose usually consist of a back pressure valve which passes steam to the atmosphere when the pressure rises to a predetermined value, and a reducing valve which admits steam to the system from some source at higher pressure when the pressure in the system becomes too low. When there is oil in the exhaust, oil separators are installed to protect the equipment using the steam.

Back pressure and reducing valves should seat tightly when closed. Correct sizing of the reducing valve is especially important, since an oversize valve often will not give satisfactory pressure control. The pressure for which the back pressure valve is set should be enough above that at which the reducing valve closes to be sure that steam will not enter the system through one at the same time it is passing out of the other.

13) *What is condensate?*

Condensate is the water formed when steam returns to the liquid state. It is formed in equipment utilizing exhaust steam and provision must be made for its removal when the steam is not in direct contact with the substance heated.

14) *Can the heat in the condensate be utilized?*

Since condensate contains an appreciable part of the original heat of the steam, in many cases 10 to 15 per cent, it is desirable to return it to the boilers or extract as much of its heat as possible in heat exchange equipment.

SEES MORE MARINE AIR CONDITIONING

A rapidly widening market on the high seas for air conditioning and refrigeration equipment is indicated by the recent installation of year 'round air conditioning equipment in nine new cargo-passenger vessels of the Grace line, according to the Carrier Corp.

Many shipping executives feel that transocean travelers to whom speed is paramount will fly, and that the consequent discounting of the speed advantage held by the large luxury liners will result in a general stepping-up of passenger conveniences on smaller cargo-passenger vessels. Several shipping lines are said to believe that their smaller ships can furnish as much comfort and luxury to ocean voyagers as the larger "de luxe" liners.

The vessels, Maritime Commission long-range C-2 type, will operate between east coast ports and the west coast of South America. Each ship will have three independent systems: one for the club lounge, bar and dining salon; one for the crew's mess and the petty officers' mess; and one for the 29 first class staterooms, the officers' quarters, the captain's quarters, and the barber shop.

HUE	VIOLET	BLUE	GREEN	YELLOW	ORANGE	RED
WAVE LENGTH	17 MIL. OF 1 INCH	19 MIL. OF 1 INCH	20 MIL. OF 1 INCH	22 MIL. OF 1 INCH	25 MIL. OF 1 INCH	30 MIL. OF 1 INCH
TYPE OF COLOR	COOL	COOL	COOL	WARM	WARM	WARM
MUSCULAR REACTION	———	24 UNITS	28 UNITS	30 UNITS	35 UNITS	42 UNITS
COMPLEMENTARY COLOR	YELLOW	ORANGE	RED	VIOLET	BLUE	GREEN
PRIMARY ASSOCIATIONS	RICH-FORMAL-LUXURY-ROYALTY	COOL-REMOTE-CALM-SOMETIMES DEPRESSING	WARMTH OF YELLOW-COOLNESS OF BLUE-NATURE REFRESHING	SUN WARMTH-STIMULATING	BRILLIANCE-CHEER-VISIBILITY	DANGER-FIRE-SOMETIMES IRRITATING
THERAPEUTIC VALUE	CALMS THE MIND-QUIETS THE BODY	REDUCES MUSCULAR TENSION	CALM PEACEFUL EFFECT	STIMULATING-OVERCOMES DEPRESSION	PARTAKES OF NATURE OF RED & YELLOW	STIMULATING EFFECT

The principles of color dynamics, showing characteristics of primary and secondary colors of the visible spectrum used to determine their functional uses

COLOR ... with a purpose

The Engineered Use of Color Aids Operation and Maintenance, Says Hayes Quinn, Color Consultant

DURING THE WAR a large factory was constructed in an eastern city; it had modern equipment and machinery and was generally considered as being an ideal industrial unit. When production started, it was noticed that the workers were unusually slow and the production schedules, although adjusted to compensate for new work, could not be met. A production control man, studying the situation, saw that many of the employees let their eyes stray upward, look around a bit, and then revert to their work. It was apparent that as they gazed at the ceiling they experienced an involuntary nervous and almost "fearful" reaction.

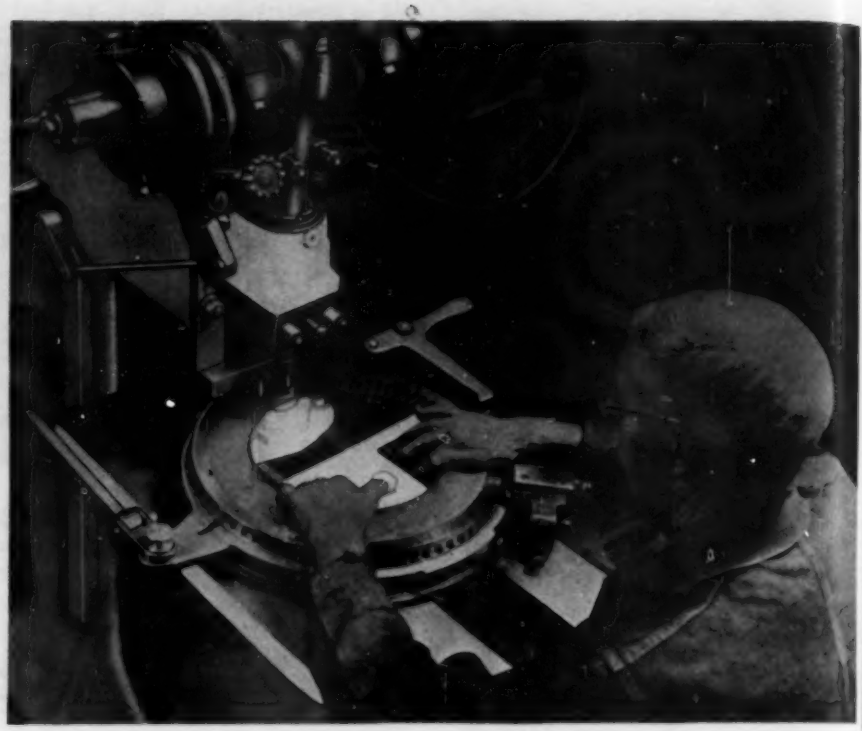
The supervisor, looking at the ceiling, discovered that there was all manner of pipes, beams, girders, and other apparatus contained in the triangular area formed by the roof. He noted that this confusing visual mass, painted a dull, light consuming, factory gray, seemed to "bear down" on him. Deciding that perhaps this was the reason for the apparent discomfiture of the employees and that they were affected with some type of claustrophobia, he sought the advice of a color expert. After examining the area, the color engineer prescribed a coat of "cascade" blue to replace the gray. This engineered use of color made the pipes, ducts, and other apparatus blend so that the overhead visual mass was "raised" from 6 to 10 ft and made to appear to recede in the distance. This proved to be the answer, as morale was heightened and production increased.

This employment of color to solve a definite production problem is but one manifestation of the phenomena of color as expressed through the newly developed color engineering principles. During the past 10 years, scientists have been studying the effects of color on people and have found that certain colors and color combinations will induce certain reactions in people. By formulizing these discoveries there has been developed the "principles of color dynamics," by which the inherent power and energy in color is harnessed to promote industrial efficiency. These principles employ practically the mental and physical reactions of the characteristics of color upon people. These characteristics include such things as hue, value, chroma, wave lengths, reflective power, and absorption.

Color Has Power and Energy

The power and energy in color used in the principles of color dynamics is derived from the fact that light consists of many waves, each producing the effect of a different color. Light is electromagnetic energy and the visible light or color is but one octave of the electromagnetic spectrum, which contains from sixty to seventy octaves. The powers of X-rays, ultraviolet, and infrared rays are well known and have been used by medical and therapeutical science to perform certain functions. These rays are neighboring octaves of the visible light rays and if the invisible rays have motion or energy, it must be concluded that the visible rays possess the similar power. The sensation of color is produced by the action of the visible waves, traveling at a rate of 186,000 miles per second, upon the eye as they emanate from an object or surface. Each material or surface absorbs some of the color waves and reflects others with the reflected waves producing the color effect upon the eye. Thus it is apparent that with these waves impinging upon the eye at such terrific rate, the surfaces of machines, work benches, walls, and floors of industrial plants should be of shades that do not irritate the eye and constitute health, safety, or production hazards.

The act of seeing—that is, the actual transmission of an image from the object to the mind—involves physical stimuli, physiological processes, and psychological reactions. All are of equal importance in consummation of the process. The stimulus is provided largely by the color of an object, although shape or form is also a determining factor. If every object were the same color, physical stimuli would be very limited and the physiological phase of the vision act would be severely strained in receiving an image. This would naturally result in physical fatigue. Fortunately, color comes to the rescue and can make the entire vision process possible with a minimum expenditure of physical energy. Color can do this because, as a member of the electromagnetic spectrum, each color has its own wave lengths and individual characteristics.



The effect of color dynamics is appreciated most on machines where close tolerance work is necessary. On this press, "focal" ivory has been used to outline the essential parts while the background is in "eye rest" green. This combination is easy on the worker's eyes and eliminates a large percentage of nervous strain where close attention is required

Color Effects on Muscular Reactions

The effects of visual stimuli have been observed upon blood pressure and muscular reaction as well as upon mental and nervous activity. For example, the effect of colored light upon muscular activity has been measured dynamometrically. In ordinary light, muscular activity was found to be 23 units, on an empirical scale. Under blue light it increased to 24 units; under green to 28 units; under yellow to 30; and to 35 and 42 units, respectively, for orange and red. Other tests have been made to show that subjecting a person to a given color for five minutes caused definite variations in physical activities, memory, and mental work.

PAINTING MECHANICAL equipment in plants and buildings has become a "science"; proper choice of colors can do much to promote morale, inspire good housekeeping, and aid operating efficiency . . . Mr. Quinn, color consultant, department of color and design, Pittsburgh Plate Glass Co., describes here the "principles of color dynamics" and cites examples of their application. If you want to keep your plant "in the pink," better get an expert to select the right shade of pink—or some other color!

The fundamental aim of color dynamic principles is to provide an "atmosphere" that will stimulate mental processes and reduce the muscular tension caused by eye-strain. This is accomplished by using carefully tested colors which afford a maximum amount of reflection with minimum absorption and glare. Color dynamics achieves this dual objective of efficiency and beauty by employing eye-rest and focal colors in planned contrast and directs their placement according to their symbolic, psychologic, and visual characteristics.

Color Can Be Helpful in Heating and Air Conditioning

Color can be an aid in the design, operation, and maintenance of heating, piping, and air conditioning equipment. Its employment in this field can be considered from four separate viewpoints. It can be used in all plants to camouflage piping and duct systems; it can be employed in power plants and stations to increase operational efficiency and reduce maintenance costs; it can assist in the efficient operation of heating and air conditioning systems; and it can be used as an effective safety factor.

In a large number of factories, heating and ventilating systems are painted black for durability or the same dull gray that was formerly used on machinery. These shades tend to make the pipes or ducts stand out visually in massive form. As was disclosed in the opening example showing the use of color in a plant, the effect of a mass of exposed pipes and ducts does have a measurable reaction upon people. It is a "trifle" that can have an effect upon plant operations.

When a piping system is installed in a plant it should be painted in the same color as the background surface to make it as inconspicuous as possible. Where such equipment rises from the floor to the ceiling, the color scheme should follow that used on the walls and ceiling.

It is perhaps in power plants that color dynamics can be most effectively used. In prescribing color schemes for these plants, the same

basic precepts are followed as are employed in other industrial units. The walls, ceilings, and other background, together with the machinery is considered as one unit. According to the basic theory of color use, the background and the noncritical or nonoperating parts of machinery and equipment should be painted in colors that will not cause eye strain and its subsequent diminishing of efficiency upon workers. The operating and critical parts of machinery or equipment should be painted in a contrasting or focal color—a color that stands out in vivid distinction to the background so that it can readily be seen in emergency.

Dual Objectives of Scientific Color

Very few power plants have as yet employed engineered color schemes, but those few that have are models of efficiency and beauty. The turbine room of the Nebraska Power Co., Omaha, is an example of the practical and decorative results obtained by selecting colors for functional purposes. This is a typically long, narrow room, the ceiling of which is filled with girders and cross beams. To eliminate this overhead mass and compensate for the narrowness of the room, a "stratosphere" gray was used on the ceiling and part way down the side walls; this is a color of a bluish-gray approximating the shade found in the sky. It causes the area to appear to be visually terminated at the top of the wall. "Seafoam" green was used for the walls from floor to "stratosphere" gray. This color was chosen for its eye rest qualities and also because it is a cool color which offsets the effects of a too strong southern exposure admitted through large windows. The floor was painted a "cruiser" gray, to blend with the "seafoam" green and to provide a light, durable wearing surface.

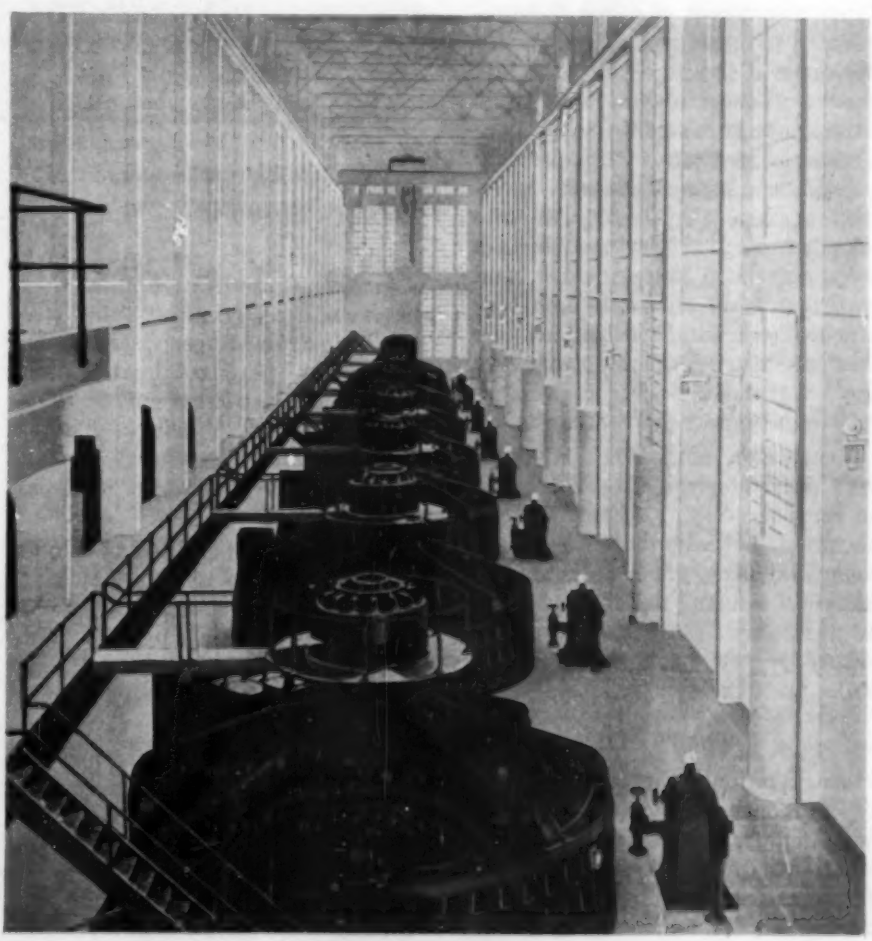
The huge main steam line was painted a "seafoam" green to reduce its apparent bulkiness so that it blended in with the background. The turbine casings and similar noncritical surfaces were finished in "vista" green, a color with both strong eye rest and decorative values. The wheel of the main steam valve, the speed control valve, the control arm from the dash pot, and the pilot valves were painted a "focal" yellow so that attendants can spot them easily. Other vital parts, such as drive shafts, oil controls, and valves, are in "focal" ivory so that they can easily be seen but not as prominently as those finished in "focal" yellow. Steps and handrails leading to the pilot valves, and a 6 in. band around the turbine casing, were treated in "focal" ivory, with the overhead crane in "focal" yellow.

It can be noted from the description of this color application that the natural interrelation of color and light is recognized and utilized in color dynamics principles. This is a particularly important phase of the scientific use of color, especially where illumination is faulty and heavy equipment plus criss-cross patterns of piping reduce the available lighting to a minimum.

Estimates of the use of lighting in the average plant show that only from 30 to 40 per cent of the total foot candles available are used. This condition probably holds true for power plants and like units. Numerous color applications, such as the Nebraska power station treatment, have proved that illumination efficiency at the working level can be increased anywhere from 50 to 100 per cent. The exact number of foot candles at working levels varies with the type of activity, but most places should have at least 35 foot candles—more where the job requires close and continuous attention.

Stimulates Good Housekeeping

The engineered color scheme of the 5000 kw Quonset Point, R. I., naval air station power plant is particularly attractive as regards both lighting and function. The ceilings of all areas were painted in a soft, light shade of "cascade" blue, which possesses the power to make them "recede." To offset a limited amount of natural illumination, "suntone"



In this generating room of a power plant, a "cameo" blue was used on the ceiling and "suntone" on the walls. This creates a pleasant and cheerful working area and the combination offsets the excessive height of the room and the great exposure. The turbine units are "vista" green

was used on the walls; this is a yellow color which imparts an atmosphere of cheerfulness. A gray was used on the floor on which traffic lanes were indicated with zone marking orange. The equipment such as pumps, motors, turbogenerators, and fans were finished in "vista" green, which blends well with the blue ceiling and yellow walls. All critical areas of the equipment such as valves, wheels, etc., were marked with "focal" yellow to provide visibility. This color scheme proved very stimulating to the employees and resulted in establishing good housekeeping practices.

In any industrial plant, it is axiomatic that good housekeeping on the part of the employees is the most effective way in which maintenance costs can be kept at a minimum. Plant after plant has found that an engineered color scheme will induce employees to keep their work areas clean. Speaking of this type of benefit derived from the scientific use of color in repainting the compressor stations of the Arkansas-Louisiana Glass Co., W. E. Nestor, superintendent, stated, "This assortment of colors definitely has a psychological effect upon a workman. Certain of these colors impart a cheerfulness. The walls provide eye rest surface and induce a sense of restfulness. Undoubtedly a desire and a sense of good housekeeping was also born with the color scheme, for workmen in this shop now keep it spic, span, and spotless. Every man agrees that he can do more with less fatigue and that the shop is just as effective and safe at 4:00 p.m. as it is at 9:00 a.m."

Ventilation engineers are benefited particularly by the results of an engineered color scheme. If employees do not keep their work areas clean and neat, trash and dirt accumulate, causing abnormal density of dust particles in the air. This naturally will have a deleterious effect upon the ventilation.

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The relationship of color to safety as it concerns piping systems has been definitely established. As was mentioned previously, the painting of the entire length of a piping system with an identifying color wreaks havoc with an overall plant color scheme and this practice has been discouraged. In place of this, color dynamics principles prescribe the painting of a color band designating the contents. In some plants it is advisable to use the color and legend only at junction or distributing points, but generally it is a wise precaution to place them throughout the entire system. The actual colors used for identifying piping systems are red for fire protection equipment, yellow for dangerous materials, and green for safe materials.*

The scientific use of color will cut down on accidents resulting from maintenance work. Much heating and air conditioning equipment affords cramped quarters for maintenance work. If this equipment is painted in colors which attract and hold light and the nonvital parts are separated visually from the essential operating elements, the task of the repair man is greatly simplified. Aisles in power plants are important to safe operations and should be marked off in color bands, preferably orange, from the remainder of the floor.

Aside from identifying piping systems, color has not been used to any great degree in heating, piping, and air conditioning work. It is true that in the hundreds of plants which have used engineered color schemes during the past two years, the heating and ventilating systems have been incorporated into the overall color scheme. Unfortunately the idea has not been carried directly into the machinery spaces.

Color, as several power station applications have proved, can be a definite aid in operations as well as making an improvement in the overall appearance. Large, bulky compressors, masses of piping, etc., in most plants are either black, red, or more usually the natural color of the finishing material of the thermal insulation. With proper color, these can be streamlined into attractive equipment. Although no guide can be given for the detailed color styling of a particular plant, if a color scheme is chosen upon the basis of the inherent characteristics of color it is certain that it will prove instrumental in furthering efficiency of operation.

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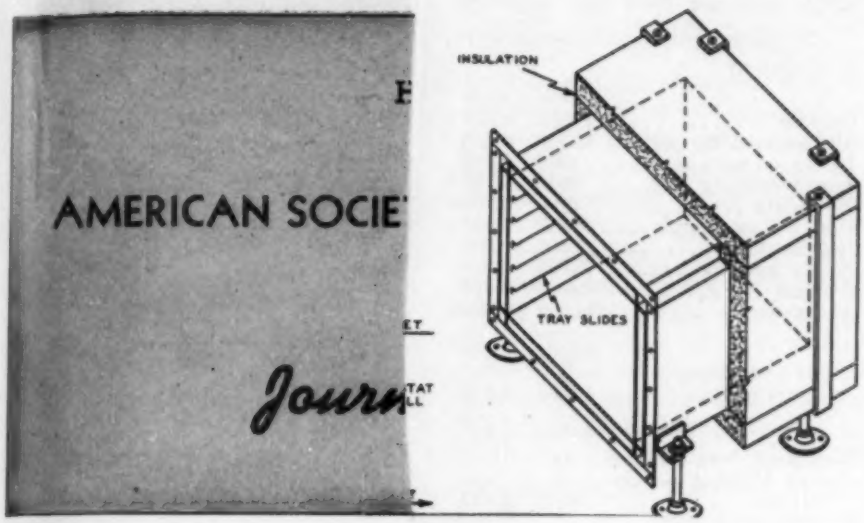

The Application of High Temperature Liquid as a Heat or Energy Transfer Medium for Domestic and Industrial Uses

By Orion O. Oaks*, Raritan, N. J.

SUMMARY—A description of the method of applying a high temperature liquid of suitable characteristics circulated from a central heat source, to the various required domestic services, including heating, water heating, refrigeration, cooking, baking, broiling, frying, ironing, generating electricity.

THE USE OF high boiling point liquids as heating media is not new, but the liquids formerly used, however, were limited in regard to maximum or minimum workable temperatures, and in many industrial applications were vaporized with the vapor being used under various pressures to obtain the desired temperatures.

The author intended to use such a liquid to obtain high temperatures without pressure and to employ the heat of the liquid only. The first experiments in 1935 were unsatisfactory due to the fact that any liquid, then obtainable by the author, having a boiling point high enough for the desired purpose had a freezing or solidifying temperature too high for practical use, especially as it was desired to use the material in the primary or exclusive heat or energy generator. The properties of the liquid now being used enabled the author to resume experiments which are described in this paper. The apparatus as developed and used is the invention of the author.

In the domestic field it is proposed to provide all of the heat and mechanical services from a single heat source and to employ a liquid as the heat or energy transfer medium to operate the various services such as house heating, domestic hot water supply, cooking, baking, refrigerating, drying, air conditioning, and generating electrical energy for light and power. This procedure is in contrast with the conventional services which may involve three or four types of heating equipment operating at various efficiencies.

By burning any preferred type of fuel, such as coal, gas, or oil, in a single furnace having a high efficiency and distributing the heat by means of the circulated heated liquid to the various equipment units where it is utilized at 100 percent efficiency, the losses are limited to those of the boiler or heater and the radiation from the transmission lines and equipment units. The efficiency of the new types of insulation, properly applied, reduces the radiation and convection losses to a small per cent, and if the efficiency of the boiler is high, the over-all performance becomes highly satisfactory.

The scope of the experiments described herein was limited to demonstrating the feasibility and practicability of the apparatus, to determine the level of convenience and ease of operation to the householder or building operator, and to exploring the extent of its application to commercial use and to industrial and manufacturing processes.

Tests of a practical type were conducted to determine the economy of the operation and the cost compared with that of conventional

the previously described units may be varied from requirements for a very small home to those of apartment houses, restaurants, hotels, hospitals, or a great institution.

Expansion Tank

The hot liquid circulates through the system at atmospheric pressure; therefore, an expansion tank is used to absorb the increasing volume of the liquid as the temperature increases. This vessel is cylindrical in form and is provided with an inlet connection from the high point of the system and an overflow pipe which discharges to the atmosphere through a low pres-

*Chief Engr., John B. Pierce Foundation. Member of ASHVE.

For presentation at the 52nd Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, January 1946, New York, N. Y.

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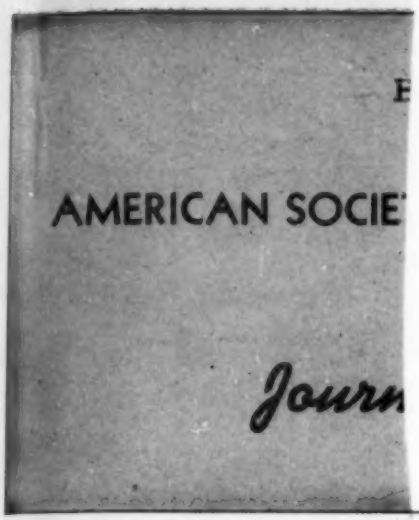

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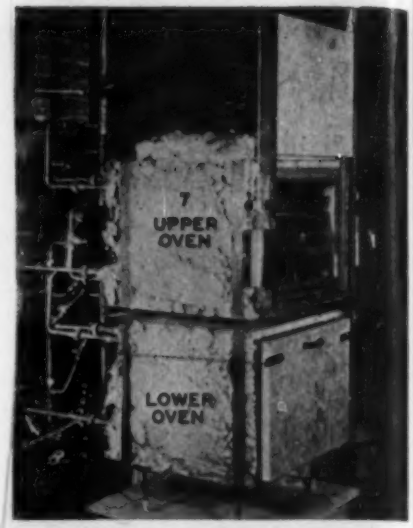


Fig. 1—Experimental installation for test of high temperature liquid as heating medium

Fig. 2—Oven units used with experimental installation of Fig. 1

equipment in current use. The method employed involves the circulation of hot liquid from the primary generator or boiler to and through jacketed baking ovens, submerged coils, radiant panels or coils, and the return of the liquid to the boiler for reheating and recirculating.

An experimental installation including (1) boiler, (2) unit heater, (3) hot water heater, (4) steam generator, (5) refrigerator, and (6) cooking unit, is shown in Fig. 1. The ovens attached to the same installation are shown in Fig. 2. Various parts of the equipment are shown as follows: Fig. 3, Boiler; Fig. 4, Expansion tank; Fig. 5, Cooking pot and recess, and Fig. 6, Upper and lower oven units. The liquid circuit is shown on the flow diagram, Fig. 7.

Primary Generator

The boiler or primary generator is of the liquid-tube, liquid-wall type with a built-in economizer and a built-in air preheater. These auxiliaries are desirable to maintain the high efficiency required of the generator because, without them, the high temperature of the heated liquid results in a high temperature of the products of combustion.

The heat exchange effected in the economizer and air preheater reduces the stack gas temperature sufficiently to make possible an overall efficiency well above 80 per cent.

Service Units

The *house heating unit* may be of the liquid-tube, air-heating type with all the necessary and customary features, such as humidifier, air filter, circulating fan and, if desired, a cooling and dehumidifying coil for summer cooling. This unit, which is under complete automatic control, is contained in a complete housing and may be located at any convenient point in the building. Hot water radiators, steam radiators, convectors, or radiant heating are a few of the means by which heating may be accomplished. Radiation and convection from *direct* circulation of the liquid through any desirable form of heating surface could also be used for heating.

The *hot water supply unit* is in the form of a heat exchanger with submerged hot liquid coils and may be of the tankless, instantaneous type or may be used in connection with a storage tank.

The *refrigerating unit* is a standard machine of the absorption type and is adapted to use with liquid heat by the simple substitution of a hot liquid coil in place of the existing heat source.

The *cooking unit* consists of metal pots of various sizes which are depressed in the insulated working table. Fitted to these metal pots are cooking utensils or liners which are provided with insulated metal covers. Set flush with the work table are a service hot plate and a flat surface griddle to be used for all surface cooking and frying. A small sink is incorporated in the work table for convenience in food preparation. For filling the utensils while in place, a combination, movable, trigger-acting faucet forms part of this equipment.

The *baking unit*, which may be located separately or built into the

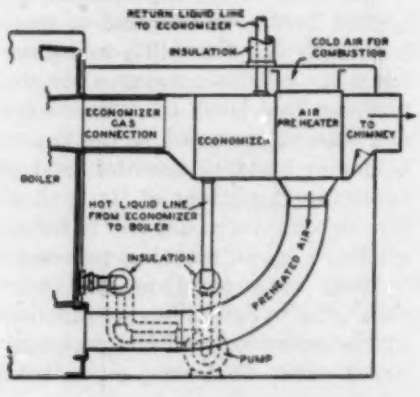


Fig. 3—Boiler unit

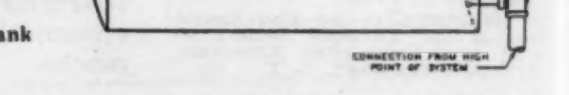


Fig. 4—Expansion tank

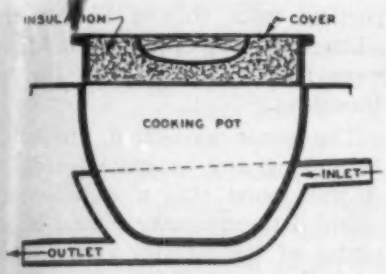
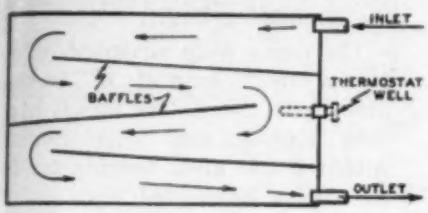
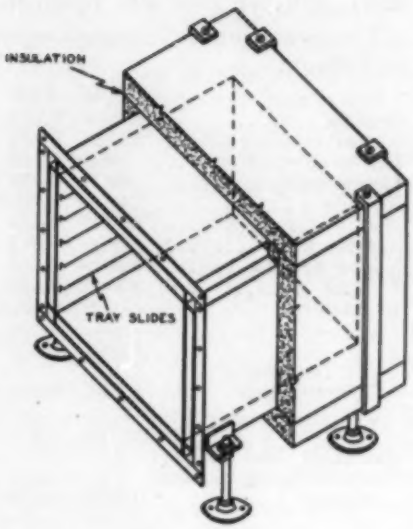


Fig. 5—Cooking pot and recess



VERTICAL SECTION THRU EITHER SIDE SHOWING BAFFLES AND THERMOSTAT WELL



GENERAL ASSEMBLY OF OVEN SHOWING INSULATION, ADJUSTABLE SUPPORTS, DOOR FRAME SUPPORTS ETC

Fig. 6—General assembly of insulated oven

work table, consists of a compartment, or compartments, conforming to standard oven dimensions and is provided with *raise-up* or *open-out* flush mounted doors as desired.

The grilling of steaks, chops, or other meats is accomplished by placing them in close proximity to the ceiling of the oven in which position results are obtained identical with, if not superior to, any other methods in current use.

Due apparently to the exclusive use of *radiant heat*, the foods are very uniformly cooked and possess a flavor and texture superior to foods cooked by other methods. This statement is made solely upon the basis of comments of laymen and experts who have eaten the food cooked by liquid heat. In general, the time required for cooking is approximately 50 per cent of that required by conventional methods.

The ovens used in the experimental plant are not ventilated, and all experiments to date indicate that no ventilation is necessary or desirable.

The ovens when suitably equipped can be utilized as a dish washer, thereby utilizing the heated surface for a rapid production of steam and boiling water which is sprayed over the dishes. After rinsing, the oven is used as an effective drying device.

The toaster consists of a jacketed tunnel, a cross section of which is approximately the shape of a slice of bread. The degree of the toasting is governed by the speed at which the bread is conveyed through the tunnel.

The time required for raising the various units from a cold condition to a working temperature varies from 30 seconds in the case of the cooking pots, griddle, service plate, and toaster to 2 min in the case of the ovens.

The drying of laundry and the dehydration of fruits and other foods are readily accomplished by radiant heat and/or convection as required. The use of liquid heat coils or surfaces controlled at the appropriate temperature and air supply is employed as, and when, required. The size and number of the previously described units may be varied from requirements for a very small home to those of apartment houses, restaurants, hotels, hospitals, or a great institution.

Expansion Tank

The hot liquid circulates through the system at atmospheric pressure; therefore, an expansion tank is used to absorb the increasing volume of the liquid as the temperature increases. This vessel is cylindrical in form and is provided with an inlet connection from the high point of the system and an overflow pipe which discharges to the atmosphere through a low pressure relief valve. A liquid gage is employed to indicate the height of the liquid in the system.

Circulating Pump

A motor driven centrifugal pump is used to circulate the liquid throughout the various units and return it to the generator for reheating and recirculation. This pump operates only against the head created by frictional resistance through the lines.

Electrical Energy

When required, electric energy is produced by means of a heat exchanger or boiler producing superheated steam at pressures varying from atmospheric to 750 psi. This steam is utilized in driving a steam turbine connected to a generator to produce electric current of whatever characteristics may be required. This turbo electric plant may be operated under various con-

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ditions, depending upon the presence of uses for process steam, availability of sufficient condensing water, or by any other factors governing power plant uses. The electric generator plant may be regarded and used as the major source of electric energy or may be considered as an auxiliary standby unit for use in the event of current failure from other sources. For domestic use the steam turbine may be operated at pressures not exceeding 15 psi in order to take full advantage of the outstanding safety and hazard-free features of the entire apparatus. In this connection it is to be noted that the liquid circuit is operated at practically no pressure throughout its entire range except that caused by its own static head.

Liquid Data

The following incomplete data may be given in connection with the liquid employed as the heat distributor or heat vehicle:

Name—Tetracresylsilicate
Boiling Point—817-825 F
Solidifying Point—Undetermined; though liquid viscous at —65F
Specific Gravity—1.13
Specific Heat—0.43
Nonpoisonous
Noncorrosive
Nonexplosive
Nontoxic
Viscosity similar to *SAE* 20 at 70 F
Extremely fluid at temperatures above 100 F

The heat transfer properties of the liquid follow closely those of other high boiling point liquids and are similar to those of water at like temperatures, namely, 300 to 600 F, which is the range that is considered in this paper.

0.021 gpm per 1000 Btu required.

The pilot plant requirements were as follows:

	Btu	gpm
Griddle	11354	0.237
3 small cooking pots	12000	0.252
Large cooking pot	8000	0.168
Large cooking pot	8000	0.168
Hot plate	4800	0.1005
Hot water supply	20750	0.435
Refrigerator	3000	0.063
House heating coil	60000	1.260
2 ovens	24000	0.505
1 toaster	1300	0.0295
	153204	3.218
Light and power (5000 watts)	42500	0.893
	195704	4.111
Radiation loss 10 percent (Piping not insulated)	19570	0.411
	215274	4.522

The pump was set to operate at 5 gpm, and at this rate the temperature drop was less than that calculated. The temperature drop actually was 125 deg with all units functioning and, of course, became less as part of the units were turned off. This would indicate that certain units consumed less heat than expected or that the pump was handling more liquid than calculated. The cooking unit apparently used less heat than expected because the drop through this unit was only 15 to 25 F.

An approximate expression of the performance of a blast coil was obtained from a test of a small heater made from copper tubing ⅜ in. outside diameter and three rows deep having a housing and an outlet face area 13 in x 10 in., or 0.905 sq ft and a total heating surface of 6.76 sq ft.

porting tests showed like results when the temperature conditions were near to those given in the foregoing.

The ovens presented difficulties in making any accurate tests, but it was found that a metallic, unshielded thermometer placed in the center of the interior volume gave a reading not more than 2 or 3 deg below the average temperature of the circulating liquid.

The ovens were unvented except for a small amount of leakage around the doors. The steady-state oven temperatures were reached within 5 min after turning on the circulating liquid and were practically uniform throughout the entire oven volume. Two ovens were constructed and mounted, one above the other, and the temperatures of both were alike at all times.

Controls

The problem of automatic controls presented requirements which could not be satisfied in the present extensive offerings of the control industry. It was necessary, therefore, to develop suitable control equipment in the experimental plant as completely as all other features. All units are automatically controlled by a standardized piece of equipment combining a three-way modulating liquid valve with a liquid-filled expansion system which serves to bypass all or any part of the flowing liquid around any unit in response to rising temperature, and conversely, to increase the supply of hot liquid through the unit upon falling temperature. Means of adjustment of the operating point and the control differential are provided so that the operator may vary the temperature of the unit at will or turn it off completely.

After setting this automatic control, the temperature of the unit is held within close limits as long as the flow of the hot liquid continues. The temperature of the hot liquid circuit from the boiler is maintained constant at any desired point. The boiler control operating the fire or the firing device is responsive to the temperature of the outgoing liquid. By this procedure any unit may be operated at a different temperature from any other unit or may be turned off completely.

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Economics

The materials used in the construction of the apparatus may be selected from a wide range of types, as they are limited only by their ability to withstand heat within the temperature range. The boiler, piping system and the various units may be constructed of either ferrous or nonferrous materials, as experimental data collected to date indicate no action by the liquid upon any metal other than that due to temperature. Joints may be either welded, screwed, flanged, or brazed. Therefore, it is apparent that the kind of material used in the piping system will be influenced by the cost of fabrication.

The exposed portion of the units such as pots, griddles, ovens, and so forth, should be constructed of a material such as stainless steel which presents a fine appearance, does not readily oxidize under high temperature, and possesses great resistance to the stresses set up by the wide range of temperatures involved. The component parts of the apparatus are subject to great flexibility regarding the relative location and may be placed according to the requirements of any type of structure, but the cost will be reduced greatly by the consolidation and streamlining of the various units so that the benefits of the prefabrication may be obtained and the cost of field construction may be reduced to a minimum. The cost of the liquid is not a serious matter, as it is more or less a permanent part of the system, does not dissipate or evaporate, and requires only very slight replenishment over long periods of time.

The underlying reason for possible savings when using the liquid heat consolidated unit is the fact that all energy conversions are 100 per cent efficient excepting in the primary generator. By concentrating on the efficiency of this primary generator and reducing the loss through radiation by utilizing improved types of insulating materials, transmission losses are reduced to a minimum, and the over-all efficiency of the entire equipment is raised to a material extent.

Conclusion

Since a full scale working model of the apparatus has been under successful test operation and study for the past year, it is concluded that for the various domestic service requirements the practicability of using a high temperature liquid of the type described in the equipment outlined has been demonstrated.

ERRATA

In the paper, A Single-Equation Design Procedure for Radiant Panel Systems, by F. W. Hutchinson, published on page 637 of the December 1945 ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, there are several typographical errors and an omission of copy by the printer. The following corrections should be noted:

At the bottom of the first and second columns on page 641, K_3 and K_4 should be defined as

$$K_3 = 0.7vK_1 + 1.08ut,$$
$$K_4 = 0.7vK_2 + 1.08u$$

In the computation "Equating 18c and 21c and cross-multiplying", toward the bottom of the first and second columns on page 641, these lines should read

$$K_3K_6 + 0.018V_cbvK_3 + vt_cK_6C_c + 0.018V_cbv^2t_cC_c$$
$$= K_4K_5 + 0.018V_c\ (K_1 - t_c)\ K_4 + vK_5 + 0.018V_c\ (K_1 - t_c)\ vC_c \quad \ldots\ldots\ldots (23)$$

At the bottom of the third column on page 641

$$A_p = 20 \times 20 = 400$$

In the first column on page 642, the lines referring to V_c, K_1, K_3, $C_{c(max)}$, and U_c should read:

$$V_c = \frac{(20 \times 20 \times 10)1}{1600} = 2.5$$

$$K_1 = 140 - 0.25 \times 100 = 115$$
$$K_3 = 0.7 \times 0.75 \times 115 + 1.08 \times 0.25 \times 100 = 60.37 + 27.00 = 87.37$$

$$C_{c(max)} = \frac{0.018 \times 2.5\ (115 \times 1.19 - 0 - 1 \times 0.75 \times 87.37) + (1.19 \times 61.87 - 87.37 \times 0.994)}{0.75\ [0.018 \times 2.5\ (0 - 115 + 0) + (0 - 61.87)]}$$

$$= \frac{0.045\ (71.32) - 13.22}{0.75\ (-67.04)} = \frac{10.01}{50.28} = 0.199;$$

$$U_c = \frac{1}{\frac{1}{C_c} + \frac{1}{1.65}} = \frac{1}{5.02 + 0.606} = 0.178$$

Heating and Ventilating for Transport Airplanes

By B. M. Brod*, New York, N. Y.

SUMMARY — Despite the rapid progress made in recent years, heating and ventilating is today recognized as the most important problem of the aircraft industry. In an effort to bring the rest of the heating and ventilating industry up to date, this paper was prepared for the purpose of presenting the present methods used in heating and ventilating aircraft.

Design Conditions

IN THE selection of outside design temperatures for an aircraft heating system, most considerations of local conditions are disregarded in favor of the more general climatic conditions and the altitude at which the aircraft is to fly. For example, certain Flagships operating throughout the United States and into Canada and Mexico have a service altitude of about 15,000 ft maximum. The heating system is sized to provide a comfortable interior when flying through outside air at —40 F. Operation at 20,000 ft maximum is anticipated in the near future. The outside design temperature will be —60 F.

The design inside condition can be found fairly accurately from the ASHVE Comfort Chart. Although it is usually considered to be +70 F, we cannot overlook the fact that, with the inside relative humidities presently encountered, a warmer temperature is more desirable. Therefore, in the selection of the interior design condition, inside relative humidities must be estimated before a truly satisfactory standard can be set up. Means of increasing humidities will be discussed later.

Preparing the Heat Load

Unfortunately, customary practice today in the sizing of an airplane's system is still too rough and ready. Although seldom undersized, systems are frequently oversized, resulting in poor control and uncomfortably high heater discharge temperatures. A rather accurate method does exist and has been suggested.[1]

Fig. 1 shows a typical section of airplane structure, the heat flow through which is illustrated in Fig. 2, the heat flow being likened to electrical flow for purposes of representation. This flow can be determined empirically from the standard heat flow formula:

$$\frac{1}{U}=\frac{1}{f_i}+\frac{x_1}{k_1}+\frac{x_2}{k_2}+\ldots+\frac{x_n}{k_n}+\frac{1}{f_o} \quad \ldots (1)$$

where

U = Overall (air to air) coefficient of heat transmission Btu per (sq ft) (hr) (deg temp. difference)
f_i = Inside (air to wall) film conductance Btu per (sq ft) (hr) (deg temp. difference)
f_o = Outside (wall to air) film conductance Btu per (sq ft) (hr) (deg temp. difference)
$x_1 x_2$, etc. = Thickness of any given wall material
k = Thermal conductivity Btu per (sq ft) (hr) (deg temp. difference per inch)

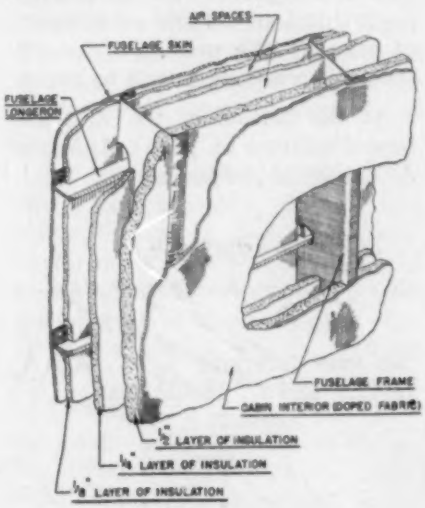

Fig. 1—Typical airplane structure and insulation

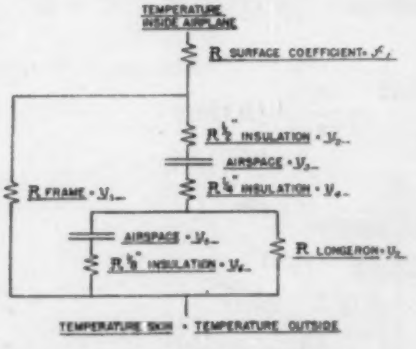

Fig. 2—Heat flow through typical airplane structure

At first glance it would appear that the heat flow through the frames and longerons could be neglected since the thickness, for example, of the frame is usually in the nature of 0.040 in. spaced about 20 in. apart. Further examination shows, however, that an error of up to 400 per cent may result from such treatment, since the value of k for aluminum is 813 Btu per (sq ft) (hr) (Fahenheit deg per inch), whereas for air space it is only 1.1 Btu. Thus parallel flow calculations must be made for all paths of heat flow in order to arrive at an accurate heat loss. Since the speed of the airplane is so great, an almost negligible surface coefficient exists for the outside of the airplane and, hence, the outside surface coefficient can be neglected.

The problem is further complicated by the lack of accurate or reliable figures for the thermal coefficients of many of the materials used for soundproofing; and by the different shape, cross-sectional area, lengths, widths, etc., of aircraft structure. At present, considerable effort and time are required to make an accurate estimate of the heat loss, but since malfunctioning of the system will result from incor-

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[1]Calculation of the Heat Loss from an Airplane, by Wilbur W. Reaser, Douglas Aircraft Co., presented before the ASME on June 18, 1941, Kansas City, Mo.

For presentation at the 52nd Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, New York, N. Y., January 1946.

rectly sizing, expenditure of the time and effort are well worth while.

Ventilation Requirements

Even after the heat loss from the airplane is known, the size of the heating plant cannot be determined until the quantity of ventilating air is computed. This is a matter which requires considerable thought since, to prevent objectionable odors, tobacco smoke, etc., as much air as possible is desired, whereas for economy of operation, reduction of humidity, etc., the minimum amount is preferable.

The humidity problem has become increasingly important of late and is likely to become even more important in the near future. Since each person gives off approximately 0.153 to 0.492 lb of moisture per hour at room temperature, the occupants of the cabin are an excellent source of humidity. The relative humidity which can be maintained in the cabin maintained at 70 F (neglecting the problems of condensation on walls and windows) can be predicted from the following formulas:

$$\Phi = 100\frac{p_w}{p_s} \quad \ldots\ldots\ldots\ldots\ldots (2)$$

$$p_w = p_s\left(\frac{P_s}{P_o}\right) + \frac{1.45}{n} \quad \ldots (3)^*$$

where

Φ = Relative humidity in cabin, per cent
p_w = Vapor pressure of moisture in cabin, inches mercury
p_s = Vapor pressure of saturated steam at cabin temp., inches mercury
p_s = Vapor pressure of saturated steam in outside air temp., inches mercury
P_s = Cabin pressure, inches mercury
P_o = Outside pressure, inches mercury
n = Ventilation rate, cfm per person

From Equation 3 it is evident that the lower the ventilation rate per occupant, the greater will be the relative humidity per person. Actually, with an airplane flying at 20,000 ft true altitude through saturated air, with the cabin maintained at a pressure equivalent to 8,000 ft altitude and with a ventilation rate of 3 cfm of outside air per person, the relative humidity in the cabin would be approximately 65 per cent.

* This formula true only for 70 deg cabin.

Obviously such a low ventilation rate in an area with such a high occupancy would soon be made intolerable by smoke and body odors, and hence a higher value must be used. At present, ventilation rates as high as 50 cfm per person are used, which accounts for the freshness of the air and the lack of smoke haze, as well as the excessive dryness in present day airplane cabins.

The low humidity in aircraft cabins today, while quite satisfactory for low-level flights in the summer time, presents a very serious problem for long range, high altitude flights throughout the year. Trans-Atlantic flight crews often refer to what they term dry-eyeballitus as a contributing factor in crew fatigue, and the American Airlines Medical Department has on a statistical basis named the excessive dryness of the air on trans-Atlantic flights as a cause for the large number of temporary minor respiratory ailments such as colds and drying of the mucous membranes.

In the operation of aircraft for long range flights, therefore, a means will have to be found for increasing the relative humidity in the cabins. Recirculation of the air constitutes one way of increasing the relative humidity, but since a considerable amount of apparatus is required to purify the air which is reused, it may prove advisable rather to use all outside air and to provide an additional source of moisture. This is one of the problems which the industry is facing today and one for which a final solution has not as yet been worked out.

On the basis of ventilation figures used for night clubs, busses, trains, and similarly highly occupied spaces, it is apparent that at least 20 cfm of equivalent outside air must be supplied per cabin occupant in order to maintain the desired cabin atmosphere. It appears today that the most economical arrangement is to provide all outside air and to provide additional moisture to the air when required. Development of lightweight air purifiers, capable of removing odors and smoke haze, may be extremely useful for air transport use.

Another limiting factor in the equivalent ventilation rate is the heater discharge air temperature. For reasons of safety, a figure of 350 F is usually used as the maximum temperature in an aluminum alloy duct, and a figure of below 300 F for most synthetic rubber ducts. The minimum air quantity which will result in a safe discharge air temperature can be determined from the following familiar formulas when the cabin heat loss is known:

$$W = \frac{H}{c_p \Delta t} \quad \ldots\ldots\ldots\ldots\ldots (4)$$

$$Q_m = \frac{W}{60 v_s} \quad \ldots\ldots\ldots\ldots\ldots (5)$$

where

W = Air flow, pounds per hour
H = Total heat loss from airplane, Btu/hr

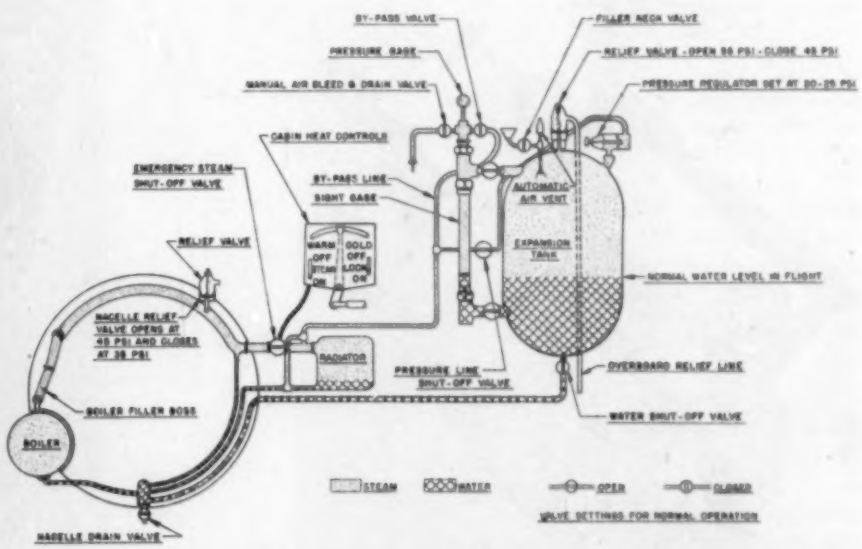

Fig. 3—Diagrammatic layout of airplane steam heating system

Fig. 4—American Airlines type aircraft steam boiler

c_p = Specific heat of air, Btu/lb
Δt = Temperature difference between inside and outside air
Q_m = Air flow, cubic feet per minute
v_a = Specific volume of air, cubic feet per pound

Since the weight of air supplied does not vary with pressure, density, or temperature, the condition under which v_a is taken will correspond to the condition for which the volume in cubic feet per minute is computed. Usually v_a is based on outside air conditions.

Having determined the quantity of ventilation air, the heat loss of the airplane is added to the heat required to bring the ventilation air to inside temperature conditions to find the size of the heating plant required. Before selecting the size, however, the type desired is usually determined.

Steam System

Most present day commercial transports of the DC-3 type carry their own steam heating systems, complete with boiler, radiator, and automatic boiler water feed systems. Although the details may vary among various operators, an understanding of one type is sufficient to understand all the others. Fig. 3 shows one such system.

The source of heat is the engine exhaust, which causes water in the boiler to be flashed into steam and carried in pipes to the radiator located in the ventilating air stream in the fuselage. Here the steam is condensed back into water and returned to the boiler. As in nearly all present day aircraft heating systems, the ventilating air for heating is introduced by the ramming action of the airplane flying through space. A pressure tap in the steam line ahead of the radiator provides a source of steam pressure which is indicated on a steam pressure gage in the cockpit and which is led into the pressure regulating valve to control the pressure in the system. Since this is an important and interesting part of the system, it will be discussed in detail.

The pressure regulating valve is a diaphragm or bellows actuated mechanism which responds to excessive pressure by closing, and to insufficient pressure by opening. Mounted on the steam expansion tank, which holds the system's excess water, it controls one of the two openings into the tank and therefore when the valve is closed due to excessive pressure, the steam above the water level in the tank is trapped and, as it condenses, the pressure in the tank decreases and circulating water is forced into the tank thereby decreasing the quantity of steam remaining and decreasing the steam pressure in the system. If the pressure becomes too low, the regulating valve opens, admitting steam above the water line in the expansion tank and forc-

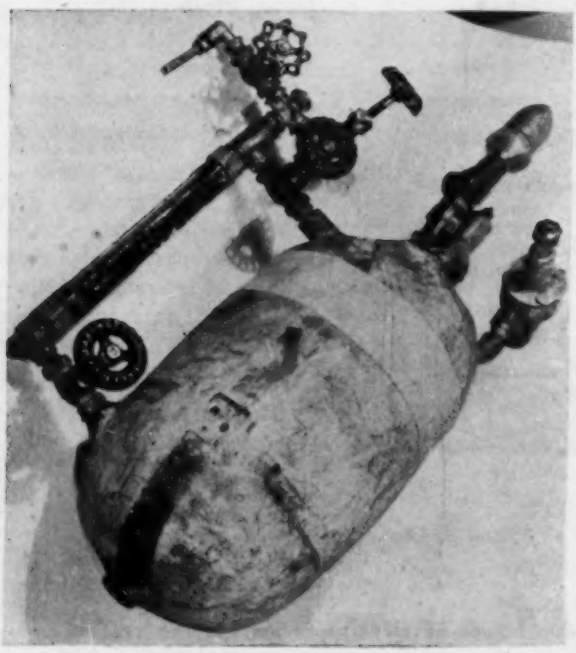

Fig. 5—Steam heating system expansion tank

Fig. 6—Aluminum aircraft steam radiator

ing water from the tank into the system where it flashes into steam and raises the steam pressure in the system. The boiler, expansion tank, and steam radiator are shown in Figs. 4, 5, and 6.

The principal advantage of the steam system is safety. Its disadvantages are: (1) its weight is approximately 108 lb or 25 lb more than an equivalent installation of an internal combustion type of heater, (2) maintenance is excessive (average boiler life is short and excessive time is consumed in changing them), and (3) a quality that can only be called general cantankerousness. The steam heating system was responsible for 248 mechanical flight delays in one year!

Exhaust Heat to Air Heat Exchanger

The simplest type of heating system is the exhaust heat to air heat exchanger, commonly called the heat exchanger. Here again, the source of heat is the engine's exhaust which gives up some of its heat in the exchanger to the ventilating air. The heated air can be diluted with cold air if desired, and the mixture is delivered to the cabin. If no heat is desired, the heated air is discharged overboard, for at all times outside cooling air must be circulated through the heat exchanger to prevent over-heating of the metal.

This system is simple and practically infallible. Its disadvantages are: (1) installation weight (comparable to the steam system), control difficulties and excessive temperatures, and (2) the rigorous inspections and periodic checks required to prevent the possibility of carbon monoxide escape into the cabin. A further disadvantage, which is also applicable to the steam system, is that these systems cannot be utilized as a source of heat for the cabins while the airplane is on the ground.

The heat exchanger system is used on many military models, as well as on transports operated by several commercial airlines. Its adherents are quick to point out that, as long as the engines are in operation, a source of heat is readily available, that no extra fuel or water are required, and that operation of the system requires no special technique. Certainly no one who has given any thought to the matter can help but be impressed by its obvious simplicity.

It must be pointed out, however, that although great strides have been made in the metallurgy of heat exchangers, the manufacturing problems are most difficult. For example, during takeoff great power is developed by the engines resulting in extremely high exhaust temperatures, at a time when only very small air flows over the heat exchanger exist. During cruise and descent, on the other hand, low power (and therefore low exhaust temperatures) and high air flow rates exist. Under both conditions, satisfactory (but not excessive) air discharge temperatures must be maintained, and the exchanger must be kept cool to prevent overheating. The lack of cooling air imposes a terrific strain on the heat exchanger, resulting in the manufacturing difficulty previously mentioned.

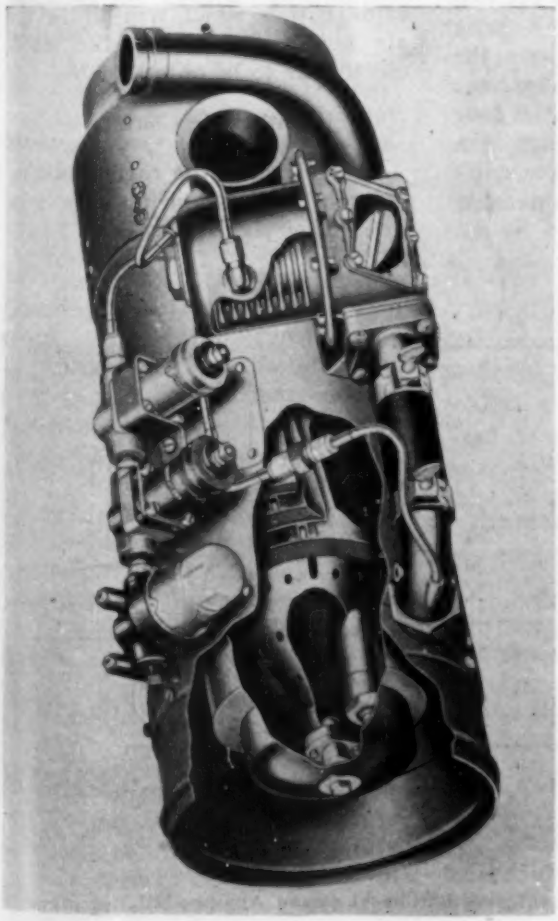

Fig. 7—Gasoline type combustion heater

Internal Combustion Heater

The newest type of heating system used in airplanes, and the lightest in weight, is the gasoline or combustion heater shown in Fig. 7. There are several designs on the market, but the ones most widely used today have the following features in common:

1. The fuel used is gasoline, which is pumped up to an atomizing type of spray nozzle under pressure.

2. The nozzle is similar to that used on gun type oil burners and delivers a fine spray of fuel into the combustion chamber where, mixed with the correct amount of air for combustion, it is ignited, burned, circulated through the heater, and discharged overboard.

3. The type of ignition may be either a hot wire or a spark plug.

4. While passing through the heater, the hot products of combustion surrender their heat to the ventilating air which carries it to the desired part of the airplane.

One 200,000 Btu per hour gasoline-fired heater has an exhaust temperature between 800 and 1,000 F, and has a high efficiency. The unit obtains high efficiency by means of an enormously high heat transfer rate per square foot of

heating surface. The high velocity air passing over the heating surface causes sufficient turbulence and speed of air to reduce the surface coefficient of heat transfer and increase the conductance. The life of these units is relatively low, as compared to a home heating boiler, but is quite satisfactory for aircraft usage where periodic replacements and careful maintenance are readily achieved.

The advantages of the combustion type heater are: (1) its light weight (a 100,000 Btu heater can be easily carried in one hand), and (2) its ready heat availability—heat can be generated on the ground without the costly and troublesome process of operating the engines. Its disadvantages are: (1) its newness—all the troublesome quirks and bugs have not been removed yet, (2) the high maintenance and inspection required to guard against carbon monoxide fumes being introduced into the ventilating air (although the quantity of carbon monoxide is smaller than that found in the case of the heat exchanger), and (3) the fact that raw fuel must be piped to the heaters.

In making a selection of the proper type of heater, the following facts must be borne in mind. Each installation is different, and whereas in one type of airplane the exhaust heater is thoroughly satisfactory, it may be completely wrong for another type of plane. While the steam system seems to be obsolescent, it is entirely possible that new improvements or new modifications on this idea may result in the extensive use of this type of system.

Between the combustion type and the heat exchanger type, it would seem that the advantages of the combustion type would outweigh those of the exchanger—but reliability and infallibility is a big inducement and, unless the manufacturers of combustion heaters can eliminate the numerous sources of failure of their units, the combustion heater may prove to be an unwise choice. In this connection, it would be well to point out that the manufacturers of this latter type of heater have been making enormous strides toward improving performance of their product.

Duct Systems

Three types of distribution systems are commonly in use. A sketch of the type used on DC-3 Airliners appears in Fig. 8. Air is brought into the airplane by the impact pressure created by the airplane flying through the air. The ventilating air is forced over the heater, into a mixing chamber where it is diluted with cold air as required and then carried down the side walls of the airplane near the floor and discharged through outlets toward the aisle. Although this system has been in use for some time, it is not completely satisfactory and occasionally passengers notice drafts around the ankles. The principal reason for dissatisfaction probably lies in the fact that the air is admitted into the cabin too near the occupants.

In order to overcome this difficulty, the second or overhead distribution system was evolved. In this system the air, instead of being forced down the side walls of the airplane near the floor, is directed aft along the center of the ceiling and is discharged downward through diffuser type outlets appropriately placed. This system also has not been found ideal because the hot air admitted so near the ceiling becomes too cold in extreme weather before it reaches the floor unless it is forced downward in a jet in which case it becomes quite uncomfortable for those passengers sitting near the outlet.

Very recently a new system was introduced—so recently, in fact, that complete information as to its performance is not available at this time. This system embodies the use of heated walls. The hot air is passed along the side walls, with branches being led into the air space between the skin and the inner lining of the airplane. In this space, heated air is carried up the side and discharged through a grille near the top of the airplane. Theoretically this system should prove superior to all other distribution systems yet introduced, and it is being watched eagerly by all operators.

Whatever type of distribution system is in use, a source of cold air should be provided for the passengers for combating airsickness and providing ventilation during hot weather flying. The cold air is usually introduced by means of individually adjustable outlets, so that each passenger can control the cold air as desired. Precautions must be taken to prevent any passenger from unwittingly annoying a neighbor with drafts. This is usually accomplished by limiting the travel on each outlet, or by using outlets which will dilute the air before it has travelled sufficiently far to be objectionable.

Automatic Control

In addition to the various safety controls necessary with each type of heating plant, there is a fertile

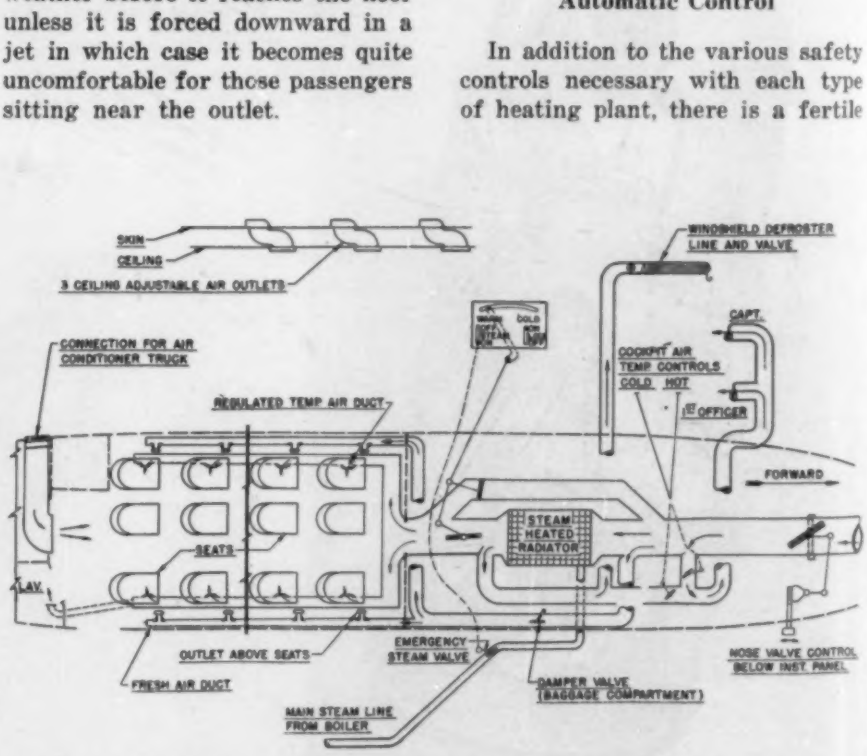

Fig. 8—Ventilation and heat distribution American Airlines DC-3 airplane

field in the airplane for automatic temperature control devices. The speed at which the airplane travels, the broadness of the territory over which it flies, and the huge air change rate necessitated by the small size of the cabin all contribute to a rapidly changing cabin temperature within an almost incredibly short time. Although present practice in the DC-3 airliner is limited almost entirely to manual control, several installations of automatic temperature control systems have been made and operators agree that such a system is almost a necessity if cabin temperature is to be maintained constant.

An interesting control system is the electronic one, in which the three controllers, the thermostat, the hot air compensator, and the cold air compensator, are made up of many turns of wire varying in resistance with the temperature. These units are wired into a circuit similar to the Wheatstone bridge, and any variation in the temperature of one of the elements causes a change in resistance inducing a current of very small magnitude. This current is amplified in the electronic amplifier controlling a special motor which opens or closes a damper. The use of the three elements produces an almost constant temperature and instant anticipation of changing heat requirements.

Excellent results with even greater reliability and less weight have also been obtained by the use of a simple electric thermostat connected to an electric proportioning damper motor. Here the change in cabin temperature is more noticeable since no anticipating element is present, but the added simplicity of the system is quite advantageous. All such equipment must be carefully mounted, since there is considerable vibration which would otherwise be quite troublesome to the thermostatic control. Thus a hovering thermostat would be jarred into an open or a closed position it might not otherwise take.

Before the subject of automatic control is dropped, it would be well to point out that the two separate *air zones* on present day aircraft must be treated separately. It is inadvisable to try to control the cockpit temperature from the cabin thermostat, or that in the cabin from one in the cockpit. Rather, in most transport airplanes today, the cockpit has its own system of manual control which the pilots can operate as required. An important feature of cockpit ventilation is the provision for supplying hot air for use in windshield defrosting.

Future Considerations

As aircraft operation improves and as comfort standards improve aboard the aircraft, many new problems will be raised. One of the most important of these is the supercharged or pressurized cabin. This will logically fall in the hands of the aeronautical air conditioning engineer, since he is responsible for the ventilation and thermal comfort of the passengers and crews.

The purpose of pressurizing an airplane is to increase the density of the air in the airplane to achieve an effective altitude in the cabin considerably lower than the altitude at which the airplane is flying. This will enable the airplane to fly at an altitude of 20,000 ft for example, with the crew and passengers suffering none of the attendant disadvantages usually associated with high altitude flying. A recent comment made by a crew member of a pressurized B-29 revealed that he felt less fatigued after a 14 hour flight on a B-29 than he normally felt on a 7 hour flight in other airplanes.

Many problems are still unsolved. For example, the problem of cabin pressure control, cabin temperature control, ventilation control, and attendant problems will have to be worked out in the future, although some of the details are known now. Many problems will arise in connection with pressurizing systems which are not yet dreamed of. But all these concern the aeronautical heating and ventilating engineer. To solve them, he will be required to coordinate information from all sources—and much of his knowledge, not only on pressurization but on all aspects of comfort in the air, must be based on information secured from the rest of the heating and ventilating industry.

HERTZLER ELECTED YORK VICE-PRESIDENT

Stewart E. Lauer, president of the York Corp., York, Pa., has announced the election by the board of directors of John R. Hertzler as vice-president. Mr. Hertzler, who was graduated from Lehigh University in 1927 with a B. S. degree in mechanical engineering, has spent his entire business career with the York Corp. In 1942 Mr. Hertzler accepted a commission in the United States Navy and held the rank of lieutenant commander when he returned recently to inactive duty.

After his graduation from college, Mr. Hertzler spent approximately two years in the shops of the company as part of the graduate engineering course. Subsequently he spent some time with the company's field organization, and was later recalled to the factory to assist in the organization and supervision of a department to cover the various aspects of one of the most technical and highly engineered phases of York's business, air conditioning.

His administrative and sales ability earned for him promotion to assistant general sales manager, and later general sales manager of York Corp. In this capacity, Mr. Hertzler has under his direct supervision the full distribution of the entire line of York products, including their sale, application, installation, service, and maintenance. This involves the organization at the factory as well as all the district offices both in this country and abroad.

During his 39 months with the Navy, Mr. Hertzler was a liaison officer of the Army-Navy Munitions Board. His work placed him in active collaboration with the general industrial equipment division of the War Production Board on production of electric motors, pumps, compressors, fans and blowers, and other equipment allied to the refrigeration and air conditioning industry. He is a member of the ASHVE and the *American Society of Refrigerating Engineers.* He is also a member of the Tau Beta Pi honorary engineering fraternity.

A Study of Several Coal-fired Magazine-feed Space Heaters

By R. C. Cross* and H. N. Ostborg,** Chicago, Ill.

SUMMARY—Performance tests of typical present - day coal - fired magazine-feed space heaters conducted for the purpose of determining the advantages and disadvantages of the basic principles upon which they operate.

WITHIN RECENT time, there has been a definite revival of interest in the development of coal-fired magazine-feed space heaters, and a number of designs of this type heater have been placed on the market. The general development program has been stimulated by the widespread use of these heaters in army establishments and, to a lesser extent, by their use for supplementary heating in homes in oil-rationed areas. A general demand by the public for the convenience advantage of the magazine feed feature also has been a contributory influence.

The factors of prime importance in the performance of this type of heater are capacity, efficiency, and smoke - producing tendency. The data presented in this discussion are the results of an investigation to determine these factors as applied to a number of heaters of different makes.

Summary

The findings of this investigation can be summarized as follows:

1. There is considerable variation in the capacities and efficiencies of coal-fired magazine feed heaters of similar external dimensions. Five of the ten heaters tested failed to meet the 50 per cent efficiency, at rating, stipulated in Bureau of Standards TS-3443, Proposed Commercial Standard for Coal-burning Space Heaters.

2. High flue gas temperatures, and excessive losses in the dry flue gas indicate a general lack of sufficient flue travel, and secondary heating surface.

3. The majority of the heaters operated with low CO_2, and high excess air in the flue gases. These heaters were provided with various methods of introducing secondary air, and it would appear that these methods are not too successful.

4. The superior efficiency of the heaters utilizing the cross-feed, and the under-feed method of burning was noteworthy. In the case of the under-feed heater, however, the serious smoke back nullified the general performance advantage.

5. The average attention period encountered in the heaters tested was approximately 18 hours. This is a satisfactory value for achievement at rated output, TS-3443 stipulating a minimum attention period of 12 hours for magazine-feed heaters.

6. With those heaters provided with secondary air admission the smoke produced, when high-volatile fuel was used, was not excessive, except for the period immediately following the charging of fuel.

7. In general, the heaters reacted positively to changes in draft, and primary air damper setting.

8. The heater using the under-feed principle of burning showed a serious fault in strong smoke-back when the magazine charging door was opened. A fair amount of smoke-back was experienced with the cross-feed heaters.

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Description of Heaters

The heaters tested were all of the magazine-feed radiant type, but they may be classified by the method of burning. Heaters A and J utilized a modified principle of cross-feed burning, with an inverted fuel bed. Heater F operated with under-feed burning with an inverted fuel bed, and the remainder of the heaters were of the conventional over-feed burning type. These latter heaters, although designated as *magazine-feed*, are truly surface-fired heaters incorporating deep firepots. The combustion chamber and so-called "magazine" are common, and magazine-feed cannot be applied in a generic sense.

For purpose of definition, it is noted that in cross-feed burning the direction of coal feed and flow of air for combustion are at right angles to each other. The coal feed and flow of air for combustion move in the same direction in under-feed burning. In conventional over-feed burning the coal feed and air flow move in opposite directions.

All of the heaters, except Heater F, provided some means for admit-

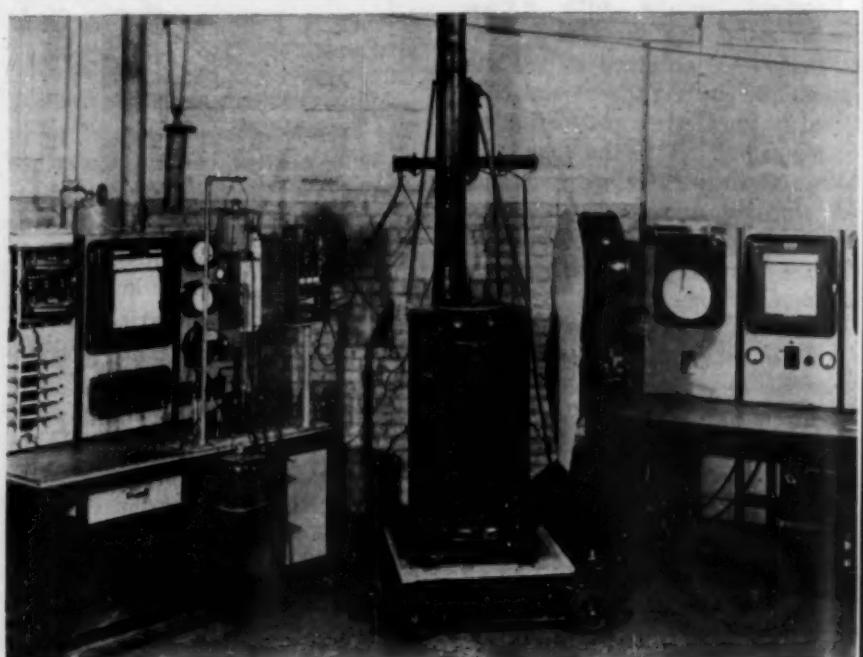


Fig. 1—General arrangement of equipment

ting secondary air into the combustion space. The effect of secondary air admission is noted in the discussion of the test results. Heaters C and H had metal liners in the combustion chamber, whereas all the other heaters were lined with refractory material.

Test Set-up

The general arrangement of the equipment and instruments used in obtaining the test data is shown in Fig. 1. In order to obtain the rate of burning directly by weight loss, the heater was set on a scale. The instruments for measuring drafts and temperatures, flue gas collection and analysis equipment, and a smoke recorder of the photoelectric type were connected to the heater in accordance with recognized test procedure.

Test Program and Procedure

The test program was divided into two parts—a series of capacity, or rating, tests with anthracite, and a series of tests with high-volatile bituminous coal to determine the smoke producing tendencies and draft reaction characteristics of the heaters.

In the anthracite tests the recorded data included the weight of coal fired, weight of ash and refuse, ashpit draft, draft at the flue gas outlet, flue gas composition and temperature, temperature of the air used for combustion, and the rate of burning was determined by weight loss of the unit. In addition to these data, the proximate and ultimate analyses of the fuel and the combustible in the ash and refuse were determined. These data permitted the determination of the stack and grate losses in a conventional heat balance. When burning anthracite there are no unaccounted for losses due to unburned hydrocarbons in the flue gases, and the heater output was obtained by subtracting the total stack and grate losses from the heat value of the coal.

A preliminary starting fire was used in all tests. During this preliminary period and the test period, the primary air damper was adjusted to provide a maximum rate of burning with the limitation of a maximum flue gas temperature of approximately 900 F. The draft at the flue gas outlet was maintained at 0.06 in. water, but because the rate of burning was regulated by the primary air damper adjustment, the output is not strictly the result of the maintenance of the constant draft value. The test period was considered ended when the flue gas temperature had dropped to 75 per cent of the average value obtained in the preliminary period.

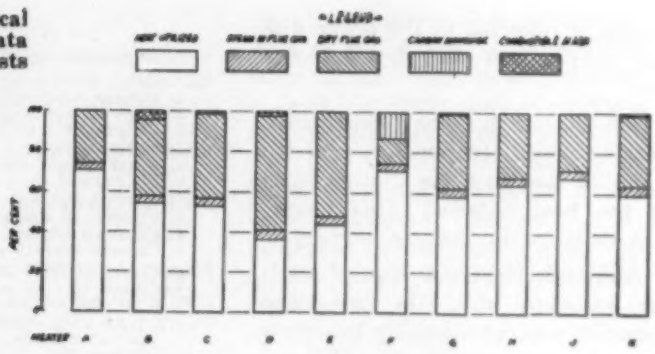


Fig. 2—Graphical heat balance data —anthracite tests

No manual attention, such as poking or shaking the grates, was given during the test period. In those heaters provided with independent control of secondary air, the secondary air inlet was set at the closed position.

The data obtained in the tests using high-volatile bituminous coal included the weight of coal fired, draft at the flue gas outlet, flue gas temperature, rate of burning, and smoke density. In addition, the magazine cover was opened momentarily at 15 min intervals for observation of fuel bed reactions.

A continuous record of smoke density at the flue gas outlet was obtained by use of a recorder of the photoelectric cell type. This instrument has been described in the literature[1] and furnishes a very accurate means of measuring smoke densities.

As in the anthracite tests, a preliminary starting fire was used. During this preliminary period the draft at the flue gas outlet was maintained at 0.05 in. water, and the primary air opening was in the *open* position.

At the end of the preliminary period a full charge of coal was placed in the heater and the test started. The test was of 6 hours duration, divided into three periods. *1st and 2nd hours:* Draft 0.05 in. water—primary air open; *3rd and 4th hours:* Draft 0.025 in water—primary air closed; *5th and 6th hours:* Draft 0.150 in. water—primary air open.

Conditions during the first period of the test were approximately those at which nominal rated output would be achieved. The second period simulated banked operation, and the third period may be considered a drive rate. The marked changes in operating conditions between the periods furnished an opportunity to observe the reaction of the heaters to *check-down* and *pick-up* settings.

No flue gas limitation restrictions were imposed, and the results are directly the effect of draft variation. Where independent means were provided, the secondary air inlet was left in full open position.

Test Results

Anthracite Tests: The anthracite used in all tests was from No. 6, D, L, and W seam, nut size, and of the following analysis:

Proximate analysis, as fired, per cent

Moisture	1.5
Volatile matter	4.1
Fixed carbon	83.6
Ash	10.8

Calorific value, as fired, Btu per lb —12,880

Carbon	76.6 per cent
Hydrogen	4.1 per cent

The leading test information is given in Table 1, and the heat balances are presented graphically in Fig. 2. A study of these data shows a large variation in the efficiencies and outputs obtained with the various heaters.

Heater A had an output of 47,688 Btu per hour at an efficiency of 70.4 per cent. This heater is designed with a liberal combustion space, and has considerable heating surface in contact with the gases of combustion. The advantage of this

[1] Bituminous Coal Research, Inc., Technical Report No. 1, Part II, Burning Tests on Four Typical Coals, by Ralph A. Sherman, E. R. Kaiser, and H. R. Limbacher, Appendix A, p. 43-47.

design is reflected in the lower flue gas temperature and dry flue gas loss.

The higher flue gas temperature obtained with Heater B is contributory to the high dry flue gas loss in the heat balance. This heater was deficient in heating surface.

Although Heater C was of similar external size, the magazine capacity was considerably less than that of the other heaters. This resulted in the shorter length of test, as all tests were conducted with the magazine filled to the normal top level. The high dry flue gas loss in this test was due in the most part to the low CO_2 and the high excess air. It was apparent that the arrangement of the secondary air tuyeres in this heater was not proper.

Heater D exhibited this same fault to an even greater extent, the excess air being very high. Heaters C and D both took the secondary air from a space common with the primary air. The desirability of separate control of secondary air is noted.

The test with Heater E gave a low CO_2 and high excess air, although separate control of secondary air was provided. As a supplement to the test of the heater as manufactured, the area of the secondary air ports was reduced, and a second test run, with improved results, as shown in the following brief summary:

Heater E	As Manufactured	Modified
CO_2—per cent	5.3	6.9
Excess air—per cent	262.0	171.0
Fuel burned—lb/hr	4.81	5.18
Overall efficiency—per cent	44.0	54.7
Output—Btu/hr	27,259	36,495

Heater F was of somewhat larger size. This is reflected in the larger fuel charge and the longer firing period. This heater was so designed that it could be operated with either overfeed or underfeed burning in inverted position. For comparative purposes, the underfeed method was employed in the anthracite test.

The CO_2 obtained in this test was good, and due to an abundance of heating surface, the flue gas temperature was low. This resulted in a low dry flue gas loss, but the loss due to the formation of *CO* was very high, and to an extent nullified the dry flue gas effect. The deep fuel bed of the magazine feed heater does not lend itself well to underfeed combustion, as the CO_2 formed in the first section of the bed is largely reduced to *CO* in the latter stages of combustion. Periodic gas analyses made during the test showed *CO* percentage as high as 5.8.

This heater was not provided with any means for providing secondary air and, unfortunately, it was not possible to make any changes to try the effect of such provision. Despite the high *CO* loss, this heater showed an efficiency of 70.8 per cent at an output of 58,088 Btu per hour.

Heater G was equipped with a separately controlled secondary air inlet. Good combustion was attained, but the heater is markedly deficient in heating surface, and the high flue gas temperature resulted in a correspondingly high dry flue gas loss.

The flue gas temperature obtained in the test with Heater H was relatively low, and as a result, the lower dry flue gas loss resulted in an efficiency of 64.1 per cent at an output of 43,923 Btu per hour.

Table 1—Test

	A		B		C	
GENERAL INFORMATION						
1. Heater designation	Cross-feed		Over-feed		Over-	
2. Type of burning						
3. Length of test-hour	18.0		16.5		12.	
WEIGHTS—POUNDS						
4. Total weight loss	84.5		70.0		47.	
5. Equivalent fuel burned	94.7		78.5		53.	
ASH AND REFUSE						
6. Weight of ash and refuse—lb	4.0		12.25		5.	
7. Combustible in ash and refuse—per cent	0.0		31.0		9.	
8. Carbon burned per lb fuel fired—lb	0.77		0.71		0.	
DRAFTS—INCHES WATER						
9. Ashpit	0.048		0.031		0.	
10. Flue gas outlet	0.060		0.060		0.	
FLUE GAS COMPOSITION, PER CENT						
11. Carbon dioxide (CO_2)	6.7		6.8		5.	
12. Oxygen (O_2)	13.7		13.6		15.	
13. Carbon monoxide (CO)	0.0		0.0		0.	
14. Nitrogen (N_2) (by difference)	79.6		79.6		79.	
15. Dry flue gas per lb of fuel, lb	28.4		25.8		35.	
16. Excess air, per cent	188.0		184.0		256.	
TEMPERATURES—F						
17. Air for combustion	72		82		86	
18. Flue gases	669		863		720	
HOURLY RATES						
19. Fuel burned—lb/hr	5.26		4.76		4.	
20. Heat release rate—Btu/hr	67,749		61,309		56,157	
HEAT BALANCE	Btu	%	Btu	%	Btu	
21. Heat lost in steam in flue gases	470	3.6	505	3.9	496	
22. Heat lost in dry flue gases	3342	26.0	4835	37.6	5470	
23. Heat lost in carbon monoxide	0	0.0	0	0.0	0	
24. Heat lost in combustible in ash	0	0.0	560	4.2	92	
25. Total measureable losses	3812	29.6	5900	45.8	6058	
26. Calorific value of fuel	12880	100.0	12880	100.0	12880	
27. Heat utilized, efficiency	9068	70.4	6980	54.2	6822	
OUTPUT						
28. Output—Btu/hr	47,688		33,200		29,743	

Although Heater J, employing the cross-feed principle, showed a relatively high CO_2 in the flue gases, the lack of heating surface and short flue travel resulted in a high dry flue gas loss. The high CO_2 value and lack of measurable quantity of *CO* indicates proper distribution and utilization of combustion air. The performance of Heater K was characterized by a high dry flue gas loss with attendant low efficiency.

A general review of the tests conducted with anthracite leads to the following conclusions:

Although the heaters, with the exception of Heater F, were all of similar external size, there is considerable variation in the output, and efficiency values.

Heaters A and F were provided with a reasonable amount of secondary heating surface, and flue travel was provided between the combustion chamber and the flue gas outlet. The advantage of this construction over the other heaters, in which the gases passed directly from the combustion chamber into the flue gas outlet, is clearly indicated by the efficiencies and outputs obtained.

The disadvantage of faulty application of secondary air, with its attendant high excess air, is evidenced by lower efficiencies, and outputs. This is particularly true of Heaters C, D, E, and K.

The anthracite test conditions may be considered as applicable for determining the rated output of the

thracite Series

D	E	F	G	H	J	K
-feed	Over-feed	Under-feed	Over-feed	Over-feed	Cross-feed	Over-feed
8.16	18.25	31.0	20.25	15.25	15.33	17.75
8.5	30.0	176.0	90.0	72.5	67.0	94.0
8.1	89.5	197.5	101.0	81.25	75.2	105.5
0.75	8.5	9.0	12.0	2.75	3.5	10.2
0.5	0.0	0.0	9.2	0.0	0.0	0.0
0.75	0.77	0.77	0.76	0.77	0.77	0.77
0.026	0.025	....	0.032	0.057	....	0.015
0.060	0.060	0.060	0.060	0.060	0.041	0.059
4.6	5.3	11.6	8.0	6.9	10.7	5.7
8.3	15.2	6.3	12.5	13.4	9.6	14.7
0.0	0.0	3.0	0.0	0.0	0.0	0.0
9.1	79.5	79.1	79.5	79.7	79.7	79.6
9.9	35.6	13.2	23.6	27.2	17.9	33.0
4.0	262.0	30.0	147.0	176.0	84.0	233.0
2	73	86	75	80	96	85
0	858	615	908	713	944	890
4.85	4.81	6.37	4.93	5.32	4.9	5.94
8	61,953	82,046	63,498	68,522	63,122	76,500

	%	Btu	%	Btu	%	Btu	%	Btu	%	Btu	%	Btu	%
3	4.0	518	4.0	474	3.7	527	4.0	492	3.8	526	4.1	563	4.4
5	57.8	6715	52.0	1678	13.0	4725	36.7	4135	32.1	3655	28.4	6376	49.5
0	0.0	0	0.0	1602	12.5	0	0.0	0	0.0	0	0.0	0	0.0
2	1.8	0	0.0	0	0.0	146	1.1	0	0.0	0	0.0	0	0.0
5	63.6	7233	56.0	3754	29.2	5398	41.8	4627	35.9	4181	32.5	6939	53.9
0	100.0	12880	100.0	12880	100.0	12880	100.0	12880	100.0	12880	100.0	12880	100.0
9	36.4	5647	44.0	9126	70.8	7482	58.2	8253	64.1	8699	67.5	5941	46.1
6		27,259		58,088		36,956		43,923		42,600		35,250	

heaters. It is pointed out, however, that although the heaters are capable of delivering the respective outputs, it does not follow that in all cases satisfactory heating of a space having a similar heat loss will be obtained. These heaters are of the radiant type and, where used to provide heat for more than one room, much depends upon the circulation of the air from room to room as governed by the heater location, and construction of the house.

Bituminous Tests: The bituminous coal used in these tests was from the Island Creek seam, 2 in. x 3 in. size, and of the following analysis:

Proximate analysis, as fired, per cent	
Moisture	1.8
Volatile matter	38.1
Fixed carbon	55.5
Ash	4.6

The principal objective of this test series was to determine the relative smoke-producing tendencies of the several heaters. The Island Creek coal was selected for the test program because of its high volatile content. Rose and Lasseter[2] have noted the following:

"As would be expected, high-volatile bituminous coals produced the most smoke and soot . . . others have reported that smoke production is proportional to the *volatile matter* of coal, which may well be the case with a limited range of coals, particularly of the bituminous class."

The results of the bituminous tests are presented in a series of graphs, Figs. 3 through 12. The flue gas temperature and the rate of burning are shown in addition to the smoke record.

As shown in Fig. 3, the average smoke density for Heater A was 1+ according to the Ringelmann Chart. Following a momentary peak of No. 4 density, immediately after firing, the smoke decreased sharply. A short peak is shown at the start of the bank-down period. The rate of burning did not decrease as rapidly as the air supply, with a resultant deficiency of air evidenced by the smoke peak. This is analogous to the momentary smoke peak found at the start of *off* period operation of the conventional under-feed bituminous coal stoker. This smoke peak at the start of the bank-down period is characteristic of all the heaters tested.

The flue gas temperature exceeded 1000 F (the maximum of the temperature measuring instrument) for about 30 min in the first section of the test. The flue gas temperature and rate of burning reacted rather slowly to checking of the fire, but an immediate response to pick-up is shown at the start of the third period. A slight amount of smoke-back from the upper magazine was found when the charging door was opened during the bank period. No top reaction was noted in the other periods.

Fig. 4 shows the test results for Heater B. The smoke peaks in the first and second periods of the test were of fairly long duration. No smoke was produced in the drive-

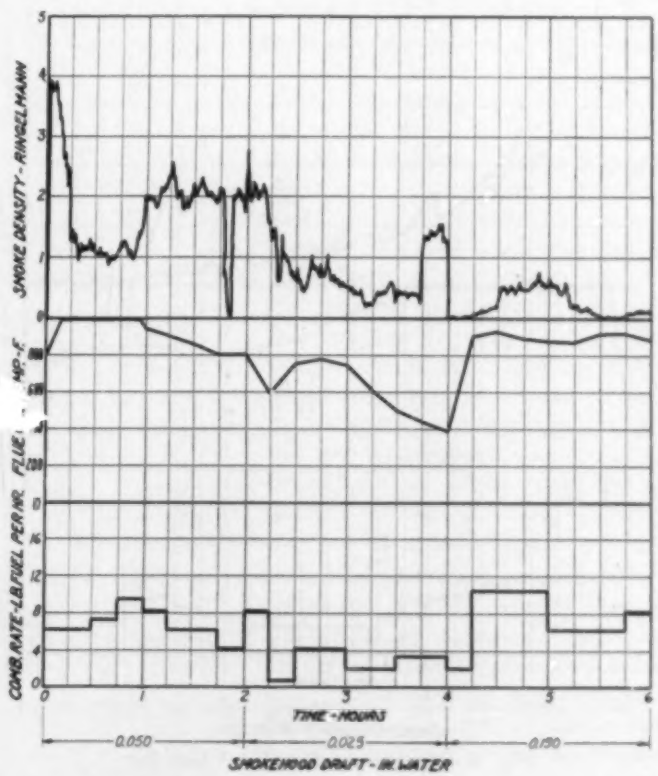


Fig. 3—Heater A Graphical test log

[2]Smoke-Producing Tendencies in Coals of Various Ranks, by H. J. Rose and F. P. Lasseter. (ASHVE TRANSACTIONS, Vol. 45, 1939, p. 329.)

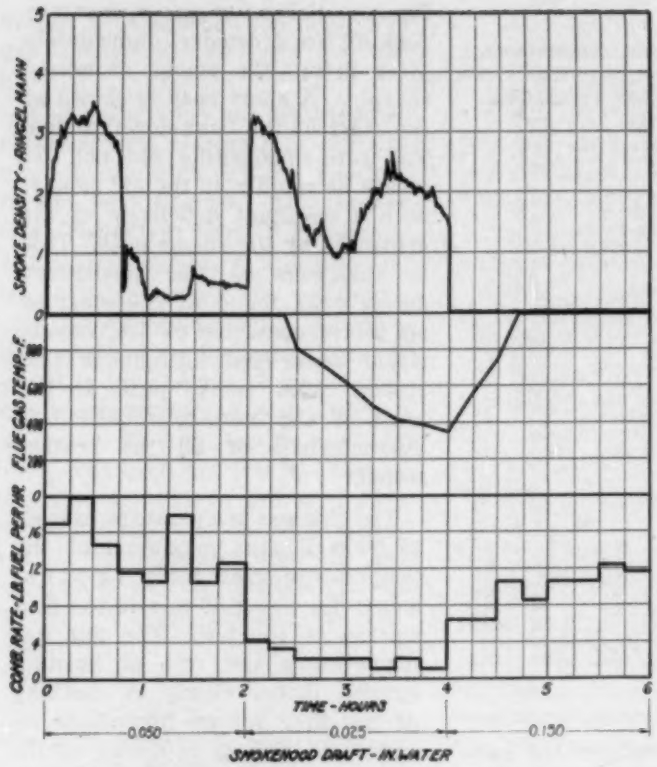


Fig. 4—Heater B—Graphical test log

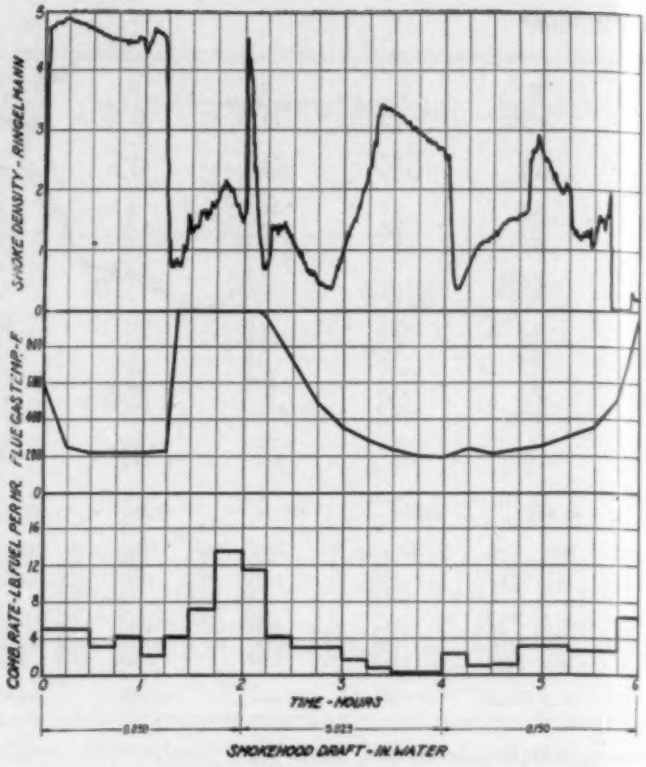


Fig. 5—Heater C—Graphical test log

rate period, however, and the average density for the entire test was 1+ Ringelmann. The absence of smoke in the last period is attributable to the rather complete coking of the coal in the previous periods and the dilution of the smoke at high excess air.

The flue gas temperature was above 1000 F throughout the entire first period, and the fuel burned at high rates. The heater reacted sharply to change of damper setting at the start of the bank-down and pick-up periods. Some smoke-back was noted when the magazine cover was opened during the first and second periods. Because most of the volatile had been released before the third period, no smoke-back was found in this period.

The smoke record for Heater C, shown in Fig. 5, indicates a long period, approximately 70 min, of

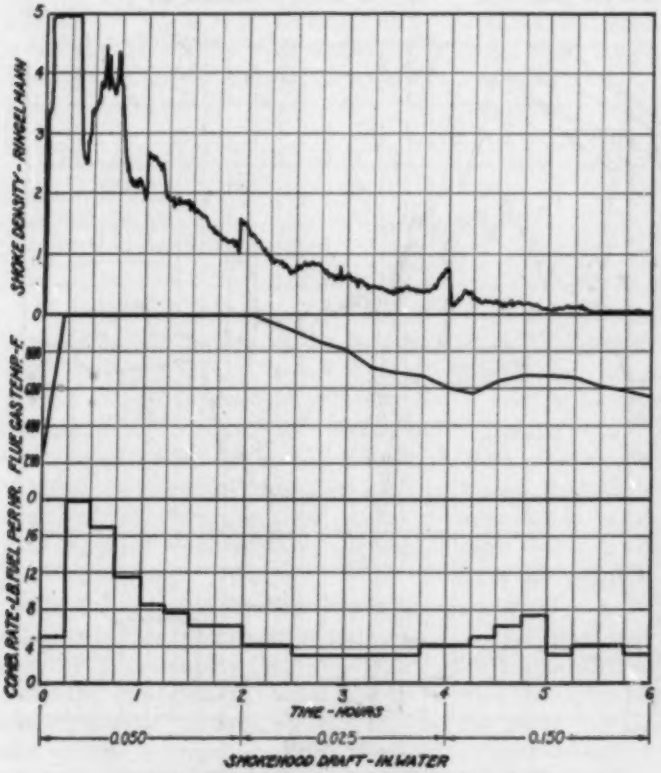


Fig. 6—Heater D—Graphical test log

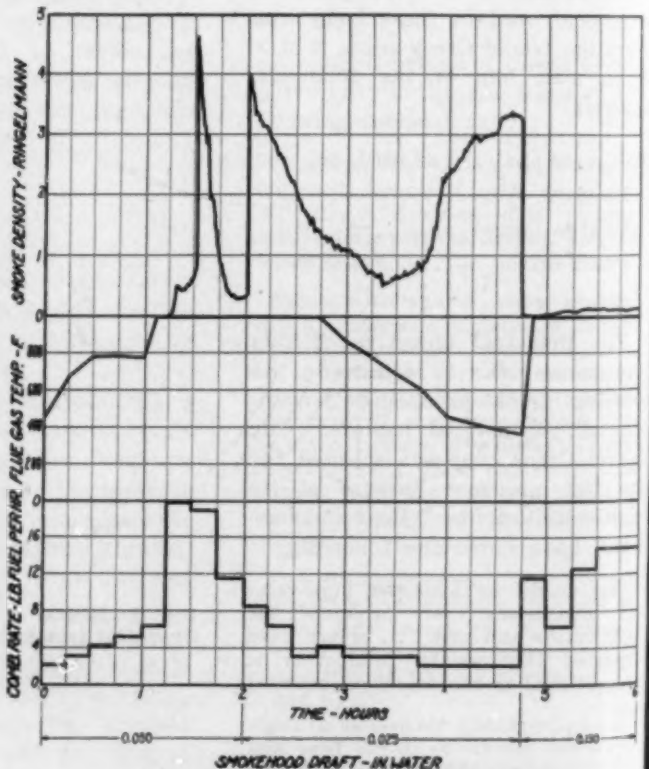


Fig. 7—Heater E—Graphical test log

dense smoke at the start of the test. The dense smoke persisted until ignition of the gases above the fuel bed was established. This is evidenced also by the temperature record. The average smoke density of 2+ Ringelmann indicates the lack of proper air supply in this heater.

The flue gas temperature and rate of fuel burning were very low until top ignition of the gases occurred. The heater responded quickly to the decrease in air supply at the start of the second period, but a very poor response to pick-up is shown in the third period. Despite the dense smoke produced by this heater in the first period, little smoke-back occurred when the magazine top was opened.

The smoke record for Heater D, Fig. 6, shows an initial peak of smoke of No. 5 Ringelmann at the start of the test. This peak tapered off steadily until the end of the first period. Smoke of less than No. 1 density persisted throughout the remainder of the test. The high rate of burning during the first period resulted in abnormally high flue gas temperatures at this time. The rate of burning did not show a marked decrease at the beginning of the bank period, as a downward trend was already well established. This was brought about by the increasing compactness of the fuel bed caused by the caking and coking of the fuel. The heater responded moderately well at the start of the pick-up period.

No smoke-back or flare was found on opening the magazine cover except at the start of the test, when strong smoke-back was noted. Ignition over the fuel bed occurred at 11 min after charging the magazine. An explosion of strong intensity was noted when this ignition was established.

Fig. 7 illustrates the results of test with Heater E. No smoke record was obtained in the early stages of the first period, but observation of later record indicates the probability of excessively dense smoke. The smoke peak at the start of the bank-down period was very sharp, and it is shown that the rate of burning immediately preceding this period was high. The bank period was conducted for 2¾ hours instead of 2 hours used in other tests.

The smoke dropped sharply to zero at the start of the pick-up period and the rate of burning increased rapidly. This is further evidenced by the immediate rise in the flue gas temperature. Some smoke-back was found in the first period, but subsequent ignition from the active fuel bed stopped this effect.

The data for Heater F are depicted in Fig. 8. Despite the principle of inverted underfeed burning employed, this heater smoked badly throughout most of the test period. It is noted, however, that no provision was made for secondary air. The lower flue gas temperatures and relatively low rates of burning are evidence of the effect of the fuel bed resistance to the flow of air for combustion. This is particularly noticeable during the bank period when very low rates of combustion were attained. It is noteworthy, also, that the response to pick-up conditions was relatively slow.

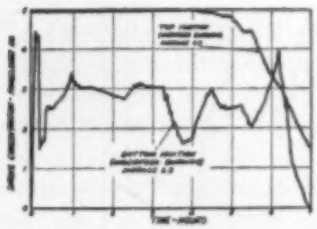


Fig. 9—Comparative smoke record (Heater F)

This test was characterized further by persistent smoke-back when the magazine cover was opened. This condition was very bad during the pick-up period. Examination of the fuel bed at the end of the test showed very strong coking and bridging, and the fuel bed was burned out in the lower section, leaving a void above the grate.

It has been stated previously that Heater F could be operated on either the under-feed or over-feed principle. As a matter of interest, trials were made of both methods. Illinois No. 6 coal, 2 in. x 3 in. size, and having a volatile matter content of 33.9 per cent, was used in these tests. This free-burning fuel was selected in an effort to equalize fuel bed conditions by the reduction of the coking and bridging effects. Tests were run at a draft of 0.06 in. water at the flue gas outlet. The flue gas temperature was controlled by adjustment of the primary air damper so that a value of 900 F was not exceeded.

The comparative smoke record, shown in Fig. 9, clearly demonstrates the advantage of underfeed burning. Although excessive smoke was produced with the underfeed method in the regular test, it is evident that the smoke would have

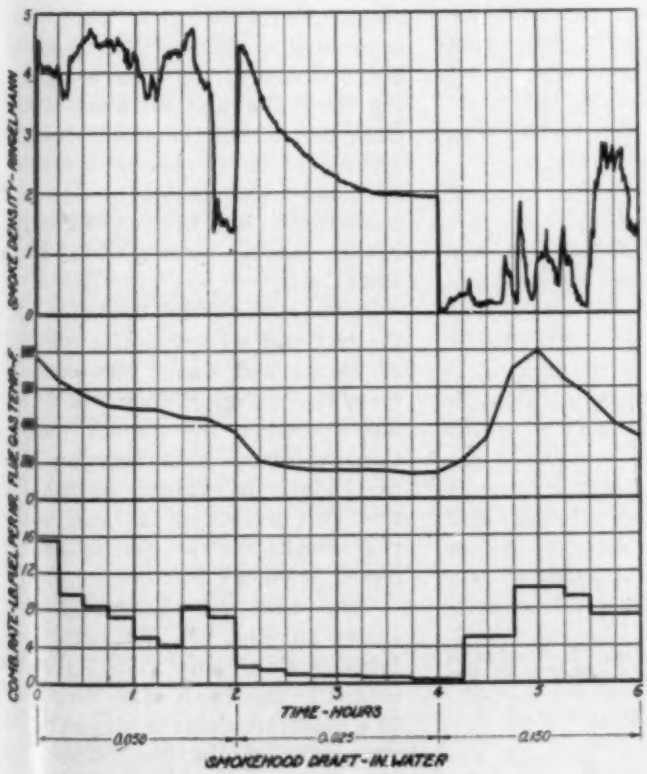


Fig. 8—Heater F Graphical test log

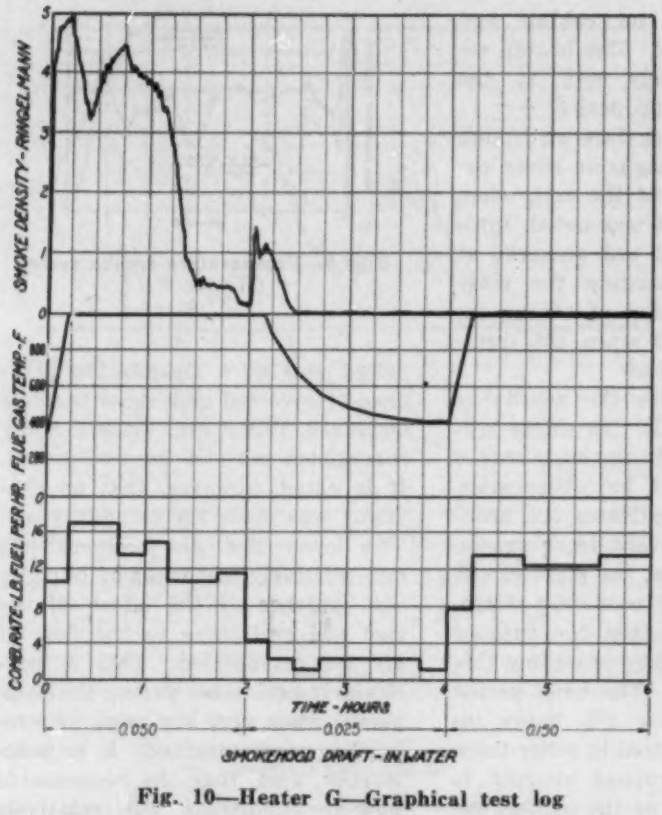


Fig. 10—Heater G—Graphical test log

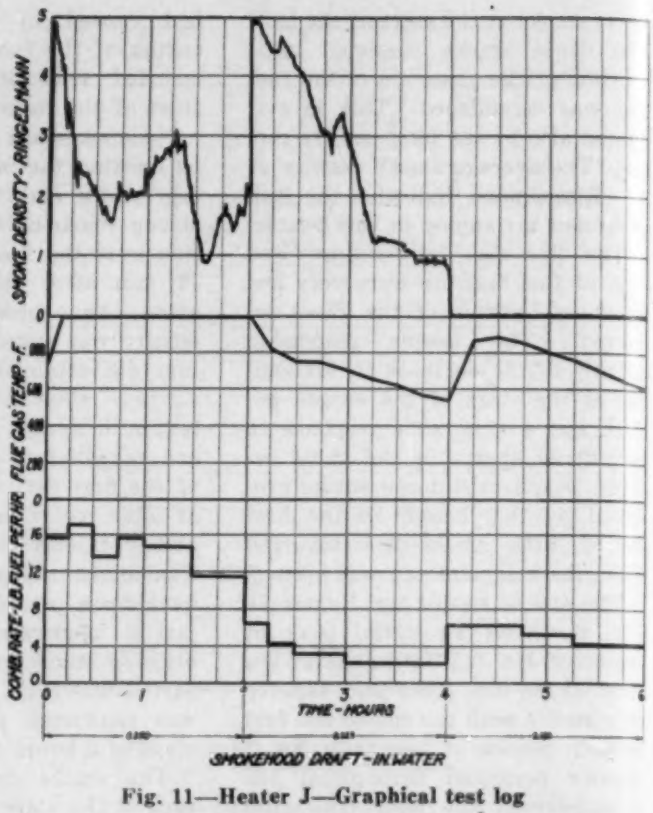


Fig. 11—Heater J—Graphical test log

been much greater if the overfeed principle had been used.

The smoke record for Heater G, shown in Fig. 10, shows a short period of dense smoke at the start of the test. The smoke diminished fairly rapidly and except for the characteristic lesser peak at the start of the bank period, no more smoke was produced. The method of introducing secondary air was quite effective in reducing the smoke emitted. The heater was very responsive to draft and damper setting changes, as shown by the sharp trends of temperature and rate of combustion at the start of the bank and pick-up periods. No smoke-back was found at any time in the test. Ignition of the gases above the fuel bed was started early in the test and was maintained.

It was not possible to test Heater H for its smoke-producing tendencies, and testing of this heater was restricted to the anthracite run previously reported.

Fig. 11 illustrates the test data obtained with Heater J. This heater showed a characteristic peak of dense smoke at the time of charging the fuel and at the start of the bank period, but the smoke density diminished fairly rapidly to acceptable limits. As shown by flue gas temperature and burning rate, the heater reacted positively to draft variations.

Some *puffing* was noted during the test and a considerable amount of smoke and flame was emitted from the charging door when this was opened at the regular inspection intervals. This reaction was particularly in evidence during the first two periods of the test, when the volatile matter was being released from the fuel bed.

Test data for Heater K are shown in Fig. 12. Following the initial peak of dense (No. 5 Ringelmann) smoke, the density decreased to a moderate value throughout the remainder of the test. This was

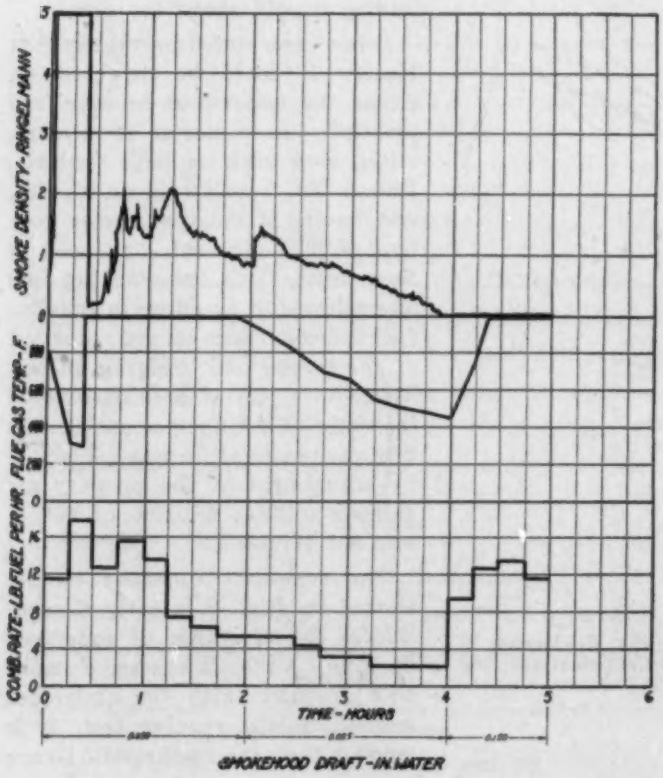


Fig. 12—Heater K Graphical test log

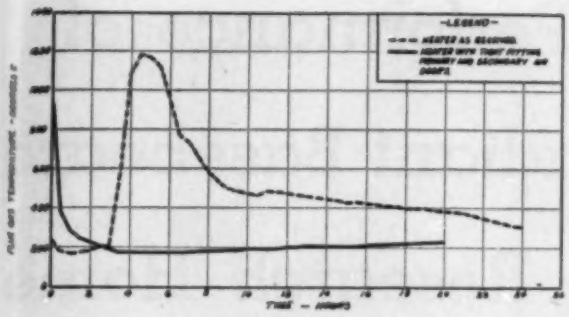


Fig. 13—Banking test performance (Heater K)

due largely to dilution, as the anthracite rating test for this heater had shown very high excess air.

The heater responded immediately, and rather sharply, to variations in draft. This is shown by the decided fluctuations in flue gas temperature and rate of burning when the test control conditions were changed. Several moderate *puffs* and a slight amount of smoke-back were noted during the first period of the test.

Banking Tests: In addition to a quick response to changes in draft and damper settings, a properly designed heater should be capable of maintaining a uniform, low rate of combustion when operating under banked conditions. This is essential in order to prevent overheating in mild weather and to insure satisfactory extended periods of low output operation. Bureau of Standards, TS-3443 states:

". . . the heater shall maintain a fire at an average fuel consumption rate of not more than 25 per cent of that required for the maximum rating for a minimum of 24 hours for magazine feed heaters."

Several of the heaters included in this program were tested under banked conditions and the following general conclusions were made: It is essential that draft doors or dampers be tightly fitting, preferably with ground joint construction; and secondary air should not be admitted in a space common with primary air, because with certain fuel bed characteristics it may function as primary air, thus preventing a proper control of rate of burning.

Fig. 13 illustrates typical results of a banking test with a high-volatile free-burning bituminous coal, showing the effect of proper and improper control of the rate of burning. The smokehood draft was maintained at 0.06 in. water, simulating cold weather operation with a reasonably effective chimney.

Conclusions

Inasmuch as the heaters used in this study were each of a different design, and three different types of fuel burning were encountered, it may be said that the results are typical of the performance of coal-fired magazine space-heaters now available. No brief is offered herein as to the relative merits or demerits of any particular make of heater, but an attempt has been made to point out the advantages or disadvantages of basic principles.

Future developments may lead to a different general situation but, for the present, this study may be found of assistance in judging the performance expectations of coal-fired space heaters of the magazine type.

INDUSTRIAL HYGIENE FOUNDATION OBSERVES 10TH ANNIVERSARY

The Industrial Hygiene Foundation of America, Inc., held its annual meeting at Mellon Institute, Pittsburgh, Pa., November 14 and 15. The meeting was very well attended by industrial management and workers in the field of industrial hygiene from all parts of the country, and was of particular interest to all who are active in the field of industrial health.

Much has been done by the Industrial Hygiene Foundation in the field of atmospheric sanitation, particularly in industry. The prevention of occupational diseases by providing a clean atmosphere has always been the goal of the organization. During the 10 years of its existence many excellent papers on the control of atmospheric contamination by appropriate ventilation have been included on the foundation's annual meeting programs and several bulletins on this same subject, useful to plant engineers and industrial ventilating engineers alike, have been prepared and issued to the member companies which now number approximately 400.

During the ninth annual meeting held in November 1944, V. P. Ahearn of the National War Labor Board and Executive Secretary of the *National Sand Association* gave ventilation top place in "A Check List on Working Conditions."

In addition to the usual annual meeting program, the foundation this year held a one-day engineering conference directly preceding the annual meeting. Even though this meeting was not publicized and attendance was restricted to one representative per company, it was attended by 74 engineers. The topics on the agenda for discussion were as follows:

a. Air Conditioning of Crane Cabs.
b. Keeping Dust Exhaust Duct Systems Clean.
c. Required Ventilation Rate for Enclosures Where Falling Materials or Moving Machinery Induce a Flow of Air.
d. Dust Collection.
e. Control of Cold Drafts in Winter.
f. Sterilization of Air.

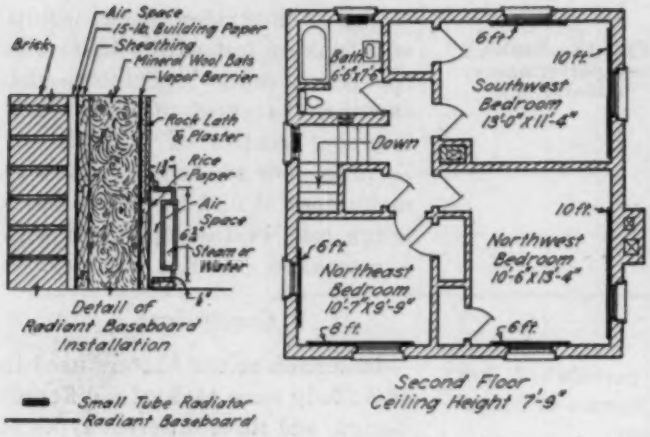
Every item on the agenda evoked lively informal discussion, and the conference was most successful. Even though this meeting could be attended by only a relatively small number of engineers, it is hoped that the same type of worthwhile and usable information may be placed in the hands of those plant and ventilating engineers who are responsible for the control of industrial atmospheric pollution through the program of research and study recently undertaken by the U. S. Public Health Service and the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.

Dr. A. D. Brandt of the U. S. Public Health Service, assigned to attended the meeting as the representative of the Research Lab- the ASHVE Laboratory, Cleveland, oratory.

Performance of Radiant Baseboard in Research Home

By A. P. Kratz* and W. S. Harris**
Urbana, Ill.

SUMMARY—The results of tests made during the 1944-1945 heating season on the performance of radiant baseboards used in connection with a two-pipe, reversed-return, gravity, hot-water heating system in the I-B-R Research Home are presented in this paper. A comparison is made between the room temperature differentials, fuel consumption, and cleanliness of operation obtained when using the radiant baseboards and when using 19-in. small-tube, cast-iron radiators. A discussion of the wall surface temperatures and the mean radiant room temperatures obtained with either type of radiation is also presented.



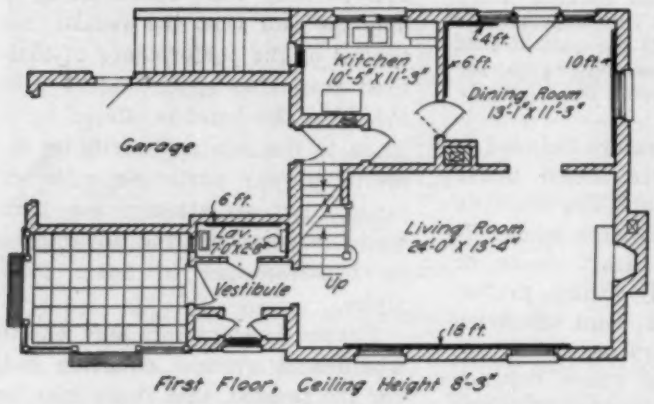


Fig. 1—First-and Second-Story Plans Showing Locations of Radiant Baseboards, Series C-44

IN THE broadest sense the object of these investigations is to study, under actual service conditions, the different types of steam and hot-water heating systems, and various changes therein, from the standpoints of the performance of the systems and their component parts and of the environment produced within the building. Corollary studies of the factors related to the performance of the structure are also to be undertaken.

The immediate object of the tests discussed in this paper was to determine the effect of introducing heat into the rooms by means of long, low panels, heated by means of hot water. These panels were placed near the floor and extended along the exposed walls of the rooms. A second object was to compare the operating characteristics of the panels with the operating characteristics of conventional, small-tube radiators installed in open recesses under the windows.

Description of Research Home and Heating System

The Research Home and heating system have been described in a previous paper.[1] The Research Home is a two-story building typical of the small, well-built American home. The construction is brick veneer on frame, and all of the outside walls and the second story ceiling are insulated with mineral wool bats 3⅝ in. thick. All windows and outside doors are weather-stripped. In addition, two storm doors but no storm windows were used. The calculated coefficient of heat transmission, *U*, for the wall section is 0.074 Btu per square foot per hour per degree F, and the calculated heat loss under design conditions for the house, excluding the basement, is 43,370 Btu per hour with temperatures of –10 F outside and 70 F inside. The total floor area of the heated space is 1,174 sq ft and the volume is 9,393 cu ft. The house was completely equipped with thermocouples, recording thermometers, humidity indicators and recorders, and all other instruments necessary in making observations on tests.

The heating plant consisted of a two-pipe, reversed-return, gravity, hot-weater heating system, installed in connection with a three-section, cast-iron, boiler having a net I-B-R rating of 55,000 Btu per hour. The boiler was supplied with a conversion-type gas burner, adjusted to a burning rate of approximately 100 cu ft per hour of natural gas having a heating value of 1000 Btu per cubic foot.

The radiators used in the living room, dining room, all three bedrooms, and the lavatory were of an experimental design made in the form of a hollow-cast-iron baseboard approximately 6 in. high. These radiators were designated as *radiant baseboards* and were installed along the outside walls of the rooms replacing the wooden baseboard, as indicated in Fig. 1. A photograph of a typical installation is shown in Fig. 2, and a close-up view of the end of the radiator with

*Research Professor of Mechanical Engineering, University of Illinois. Member of ASHVE.
**Special Research Assistant Professor of Mechanical Engineering. Member of ASHVE.

[1] Performance of a Hot-Water Heating System in the Research Home, by A. P. Kratz, M. K. Fahnestock, W. S. Harris, and R. J. Martin (ASHVE TRANSACTIONS, Vol. 48, 1942, p. 163.)

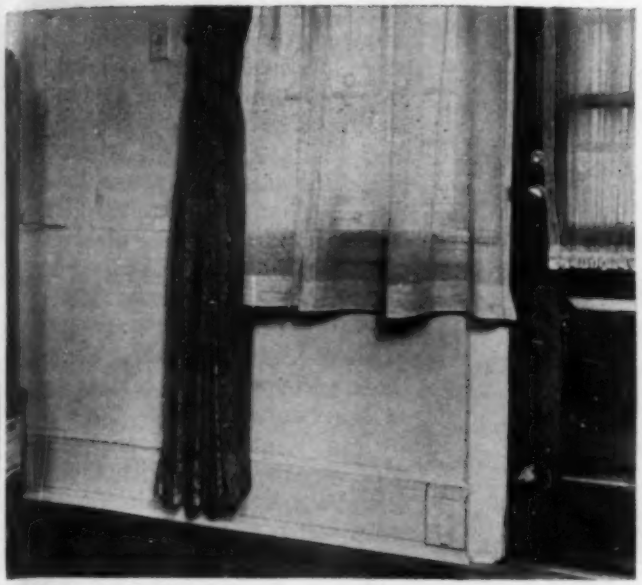


Fig. 2 — Typical Installation of Radiant Baseboard

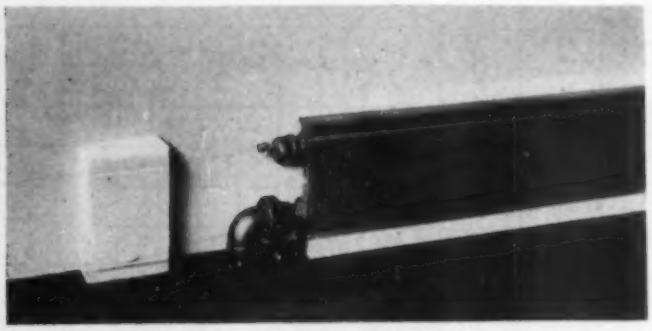


Fig. 3—Close-up View of Radiant Baseboard with Access Box Removed

access box removed, illustrating the method of making the pipe and vent connections, is presented in Fig. 3. A cross-section through the wall and radiator showing the method of installation is presented in Fig. 1. Rice paper served as a dust seal to prevent the possibility of streaking the walls. Small-tube type, 19-in., 4-tube cast-iron radiators, shown by blackened rectangles in Fig. 1, were used in the vestibule, the kitchen, the bath, and on the stair landing. This system was designed to operate with a mean water temperature of 215 F and a 30 F drop through the radiators. The amount of radiation, together with the size of risers, are shown in Table 1. The amount of radiation used was just sufficient to offset the calculated heat loss of the house at design conditions. The results obtained with the radiant baseboards were compared with those obtained from a similar plant in which conventional small-tube radiation installed in open recesses under the windows was used. The amount of radiation and riser sizes are shown in Table 1. Both plants were controlled by means of a heat anticipating thermostat located 30 in. above the floor in the living room.

Test Procedure

General Procedures: During all of the tests a gas burning rate of approximately 100 cu ft per hour was maintained. The burner was adjusted so that a CO_2 content of from 9 to 10 per cent was obtained at the smoke outlet of the boiler. Natural gas of 1000 Btu per cubic foot gross heating value was supplied from the Texas-Oklahoma pipe line.

The doors between rooms were open at all times. Observations of the room air temperatures as determined by the thermocouples located 3 in., 30 in., and 60 in. above the floor, and 3 in. below the ceiling were recorded at 7:00 a.m., 11:00 a.m., 5:00 p.m., and 10:00 p.m. The temperatures of the air in the basement and the attic, and the relative humidity in the heated portion of the house were also observed at these times. Complete daily records were made of the operating time, the number of cycles and the power consumption of the gas burner and circulator, and the cubic feet of gas consumed. Recording instruments were used to obtain continuous records of the stack temperature and draft, the CO_2, the temperature of the water at the boiler outlet and return, the outdoor air temperature, the indoor relative humidity, and the air temperature in each room 3 in. and 30 in. above the floor and 3 in. below the ceiling. Other daily observations included the total amount of electricity, gas, and water used in the house, and the general weather conditions.

Results of Tests

Room Temperature Differentials: When changes were made for each series of tests, all of the radiators in the second story bedrooms were replaced while some of those on the

Table 1—Radiation and Risers Used in Heating Systems

	Series C-44, Radiant Baseboards, Gravity Hot-Water System				Series S, Small-Tube Radiators, One-Pipe, Forced-Circulation Hot-Water System		
	INSTALLED RADIATION		RISERS		INSTALLED RADIATION	RISERS	
SECTION	19 In. Small Tube Sq Ft	Radiant Baseboard Length Ft	Size In.	Length Ft	19 In. Small Tube Sq Ft	Size In.	Length Ft
S.W. Bedroom	....	16	½	25.7	12.8	½	31.3
N.W. Bedroom	....	16	½	25.7	16.0	½	32.5
N.E. Bedroom	....	14	½	33.0	16.0	½	32.0
Bath	17.6	..	½	35.6	17.6	½	42.3
Stair Landing	11.2	..	½	33.0	11.2	½	38.1
Kitchen	17.6	..	¾	15.9	17.6	½	18.9
Dining Room (W)	....	10	¾	7.2	22.4	½	11.7
Dining Room (S)	....	10	¾ ½	9.3 0.6			
Living Room	....	18	¾	8.4	14.4 12.8	½ ½	14.5 13.9
Vestibule	25.6	..	¾	20.2	25.6	½	28.6
Lavatory	....	6	¾	29.2	14.4	½	28.6

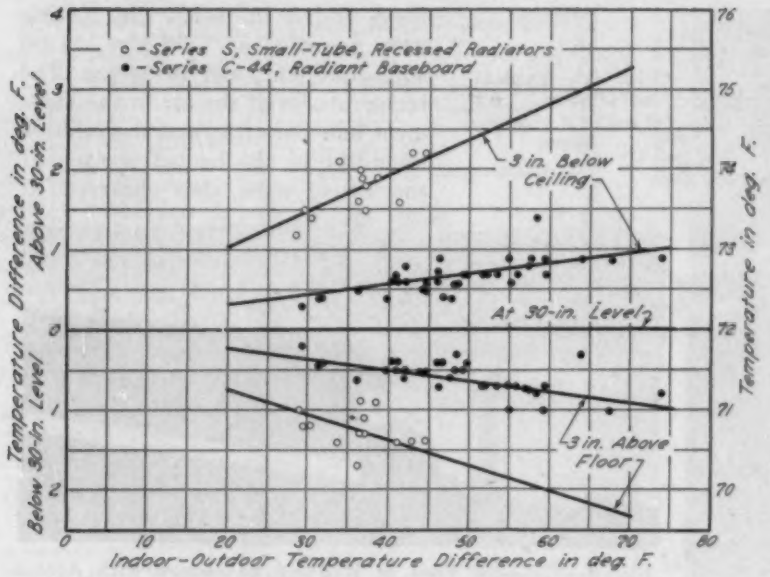

o - Series S, Small-Tube, Recessed Radiators
• - Series C-44, Radiant Baseboard
3 in. Below Ceiling
At 30-in. Level
3 in. Above Floor
Temperature Difference in deg. F. Below 30-in. Level Above 30-in. Level
Temperature in deg. F.
Indoor-Outdoor Temperature Difference in deg. F.

Fig. 4—Second-Story Air-Temperature Differentials

first story were left unchanged. Hence, it was considered that only the air temperature differentials observed in the second story should be used in making comparisons of the operating characteristics of the two types of radiators, and the following discussion has been confined to data obtained in the three bedrooms. Data obtained in the first story rooms showed characteristics similar to those obtained in the second story rooms except that the floor to ceiling temperature difference was from 1 to 2 deg greater.

As shown in Fig. 4, at an outdoor temperature of zero F, when the three bedrooms were heated by the radiant baseboards, the average floor to ceiling temperature difference was only about 2 deg, as compared to 5½ deg obtained when the rooms were heated by conventional recessed radiators. For the sake of clarity, only the temperatures 3 in. below the ceiling, at the 30-in. level, and 3 in. above the floor are shown. However, when the radiant baseboards were used, series C-44, the temperature at the 60-in. level was the same as that 3 in. below the ceiling. Thus the entire temperature difference occurred within a zone extending from 3 in. above the floor to the 60-in. level. At an outdoor temperature of zero F, the temperature 3 in. above the floor was 71.1 F, the temperature at the 30-in. level was 72.0 F, and the temperatures 60 in. above the floor and 3 in. below the ceiling were each 72.9 F, while the corresponding temperatures for series S, with the conventional recessed radiators, were 69.7 F, 72.0 F, 73.3 F and 75.3 F, respectively. Thus, it may be observed that the use of the radiant baseboards resulted in a temperature 3 in. above the floor 1.4 deg higher than that obtained with the conventional recessed radiators. It may be further observed from Fig. 4 that this difference between the temperatures at the 3-in. level increased as the outdoor temperature was decreased.

Even more striking evidence of the tendency of the radiant baseboard to produce warm air near the floor is presented in the case of the lavatory on the first story. The floor of this lavatory, which adjoined the unheated garage, was an extension of the concrete floor of the porch and was laid directly on the ground. Conditions in the lavatory, which proved extremely difficult to heat with a conventional recessed radiator, are typical of those encountered in certain types of basementless houses. As shown by Fig. 5, at an outdoor temperature of zero F, and with the same temperature at the 30-in. level, the substitution of the radiant baseboard for the recessed radiator resulted in an increase of 6 deg in the temperature of the air 3 in. above the floor. Furthermore, with the radiant baseboard the temperature of the air at the 3-in. level was essentially the same as that at the 30-in. level.

Since radiant baseboards are so designed that they extend along practically the full length of the exposed wall of the room, nearly all of the downward currents of cool air from the exposed walls and windows are intercepted by upward currents of heated air from the ra-

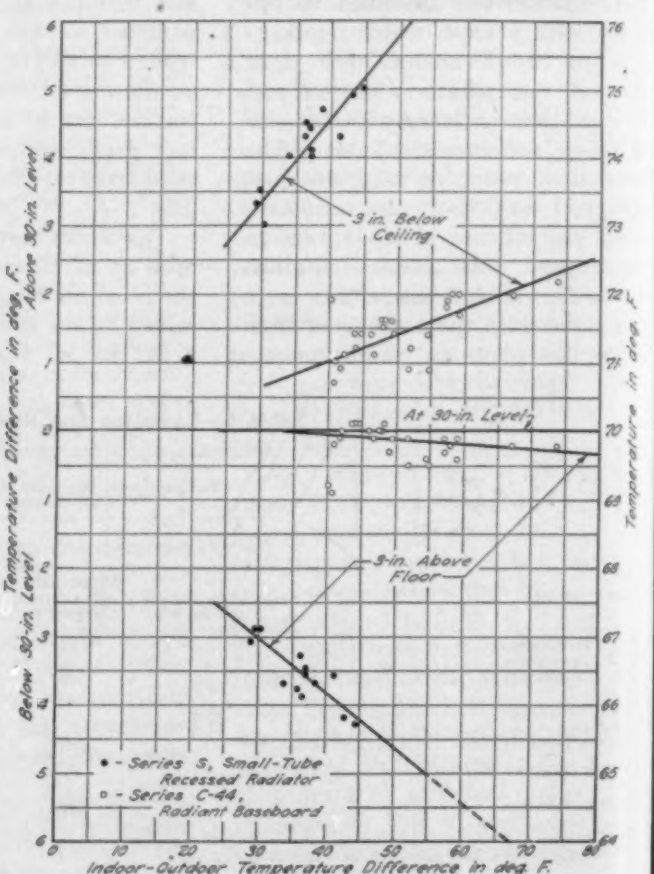

3 in. Below Ceiling
At 30-in. Level
3-in. Above Floor
• - Series S, Small-Tube Recessed Radiator
o - Series C-44, Radiant Baseboard
Temperature Difference in deg. F. Below 30-in. Level Above 30-in. Level
Temperature in deg. F.
Indoor-Outdoor Temperature Difference in deg. F.

Fig. 5—Lavatory Air-Temperature Differentials

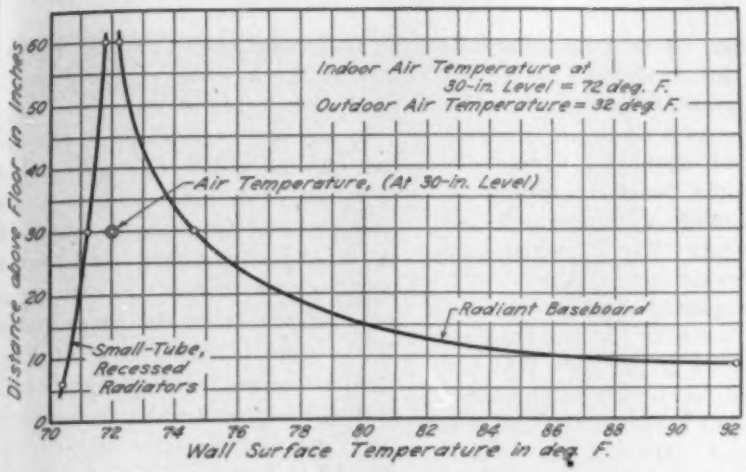

Indoor Air Temperature at 30-in. Level = 72 deg. F.
Outdoor Air Temperature = 32 deg. F.
Air Temperature, (At 30-in. Level)
Radiant Baseboard
Small-Tube, Recessed Radiators
Distance above Floor in Inches
Wall Surface Temperature in deg. F.

Fig. 6—Inside Surface Temperature of North Wall of Living Room

diant baseboard. The mixing of these two currents produces a mass of air having a temperature very close to that being maintained in the room. Thus the possibility of pools of cool air at the floor level and of warm air at the ceiling are virtually eliminated. Another factor which probably contributes to the tendency of the radiant baseboard to produce warm floors is that the floor itself acts somewhat as an extended radiator heating surface. The floor directly under the radiant baseboard is heated almost to the temperature of the radiator. The heat then travels horizontally through the floor at a rate dependent upon the [illegible] conductivity of the flooring material. This effect is greatest when the material used in the finished floor has a high thermal conductivity, as it had in the lavatory.

A cold floor is a major factor in contributing to discomfort in otherwise well heated rooms, hence the tendency to produce a warm floor may be regarded as an important attribute of radiant baseboards. This attribute is most important in the case of the basementless house in which cold floors are particularly prevalent. Therefore, the use of radiant baseboards is especially adaptable to this type of construction.

Wall Surface Temperatures: Fig. 6 shows the wall surface temperatures, measured on the inside surface of the plaster on the North wall of the living room, resulting from the use of the conventional recessed radiators and the radiant baseboards. At the times that these observations were made, the outdoor temperature was approximately 32 F and the temperature of the air in the living room at the 30-in. level was 72 F. It may be observed that with the radiant baseboard the temperature of the entire wall below the 60-in. level was greater than the temperature of the room air at the 30-in. level, whereas with the conventional recessed radiator the temperature of this portion of the wall surface was from 0.2 to 1.6 deg below the temperature of the air at the 30-in. level. Thus the radiant baseboard warmed the entire surface of the portion of the exposed wall along which they were installed. On the other hand, with the conventional recessed radiator, only the small portion of the wall forming the back of the recess was warmed, and this contributed nothing to comfort because this portion of the wall was hidden by the radiator, which was at a much higher temperature.

If all other factors except the wall surface temperature remained unchanged, the increase in the wall surface temperatures accompanying the use of the radiant baseboard would result in an increase in the mean radiant temperature in the room. However, measurements made at the 30-in. level by means of both a thermo-integrator and a globe thermometer in five different locations in the living room proved that with conventional recessed radiators the mean radiant temperature was about 1 deg higher than the air temperature and, with radiant baseboards the mean radiant temperature was from 0.5 to 1.0 deg lower than the air temperature. This condition is just the reverse of that to be expected from the wall surface temperatures obtained with the three types of radiation. The higher mean radiant temperature obtained with the conventional recessed radiators must have been the result of the higher ceiling temperatures accompanying the use of these radiators. These mean radiant temperature observations indicate that, even though the use of radiant baseboards results in warmer air near the floor and in warmer inside surfaces for the exposed wall, in order to produce the same degree of comfort it would still be necessary to maintain the same, or even slightly higher, air temperature at the 30-in. level with the radiant baseboards than would

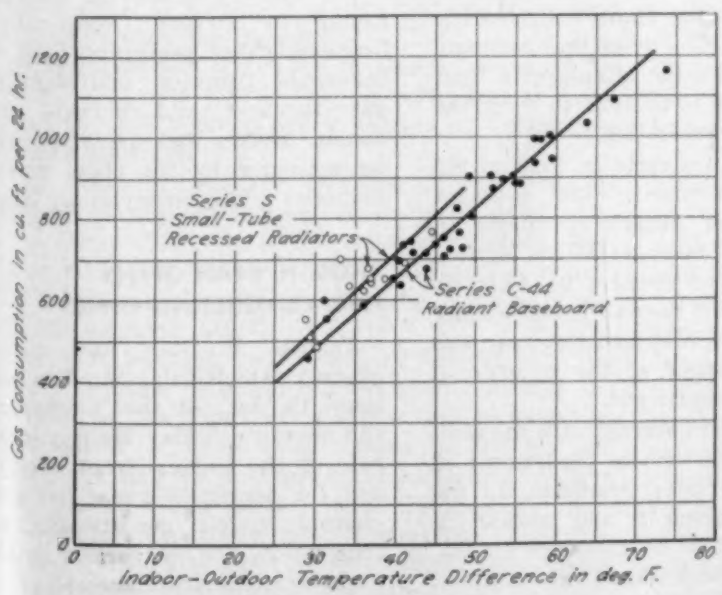


Fig. 7—Fuel Consumption Curve

be required with the conventional recessed radiators. Hence the main advantage of the radiant baseboard lies in the fact that the use of this type of radiation insures that warm floors will be obtained.

Fuel Consumption: The fuel consumptions obtained with the two types of radiation are shown in Fig. 7. It may be observed from the curves for series S and series C-44 that when radiant baseboards were used a reduction of approximately 8 per cent occurred in the fuel consumption. In the latter case, however, the radiators were used in connection with a gravity system, and owing to the large size of the pipes, it was necessary to insulate the basement mains in order to prevent overheating the basement. As a result, an air temperature of about 70 F was obtained at the basement ceiling as compared with a temperature of approximately 75 F when the forced-circulation system, with small uninsulated mains, was used in connection with the conventional radiators. It is probable that the decrease in fuel consumption should be attributed to this 5 deg decrease in basement temperatures which caused a decrease in heat loss from the house. Hence it seems safe to assume that no material difference in fuel consumption can be attributed to the inherent characteristics of the two types of radiation.

In any case, variations in the effect of wind and sunshine are liable to result in deviations of as much as 5 per cent from the averages of the fuel consumptions represented by the plotted curves. For this reason differences in the magnitudes of the order of those shown in Fig. 7 cannot be regarded as significant, and to all intents and purposes the fuel consumptions obtained with radiant baseboards and the conventional recessed radiators can be considered as practically the same.

NEW VICE-PRESIDENTS ELECTED BY HONEYWELL

Election of four vice-presidents of the Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., establishment of two new executive posts and changes in the sales and production divisions were announced recently by H. W. Sweatt, president of the company.

The new vice-presidents are P. B. Wishart, in charge of factory operations in Minneapolis; A. H. Lockrae, in charge of the heating controls department; J. E. Haines, a member of ASHVE, in charge of the commercial controls department, and C. D. Lyford, who will be in charge of sales to the gas industry.

The board of directors of the company has also elected C. B. Sweatt and W. L. Huff to the new positions of executive vice-president. J. H. Binger was elected assistant secretary.

Other changes in company management include the appointment of Thomas McDonald as vice-president in charge of sales. Mr. McDonald, who has been vice-president in charge of the aeronautical controls plant in Chicago, will assume direct responsibilities for those activities formerly supervised by Mr. Sweatt. A. M. Wilson, also a vice-president, will be in charge of all company activities in connection with aeronautical controls and will coordinate development, manufacturing and sales operations of this division with other divisions of the company.

John E. Haines

Each of the newly elected vice-presidents has been with the company for many years, except Mr. Wishart, who joined in 1942 as assistant superintendent in charge of production and was subsequently made factory manager in charge of all production in the company's Minneapolis plants.

Mr. Lockrae came to the company from the Honeywell Heating Specialties Co., when that company merged with the Minneapolis Heat Regulator Co. in 1927 to form the present organization.

Mr. Haines came in 1929 to the sales department, was assistant manager of branch operations in New York, manager of the National Regulator division in Chicago, manager of the air conditioning controls division and last year was made manager of the commercial controls department.

Mr. Lyford started with the company in the service department in 1919, was later promoted to the sales department and served in various sales divisions until 1925, when he was placed in charge of sales to the gas industry.

TO CONTINUE MANUFACTURE OF AIRCRAFT HEATERS

C. B. Phillips, vice-president of Surface Combustion Corp., Toledo, Ohio, has announced that the manufacture of Janitrol aircraft heaters, which was a wartime development for military planes, will be continued.

Robin A. Bell, who headed wartime sales of the aircraft heaters, has been appointed sales manager of the newly-established Janitrol Aircraft Heater division of the heating equipment manufacturing company. In addition to directing sales to the established aviation market, Mr. Bell will explore possible applications for the aircraft heater with the *whirling flame* in other fields.

The decision to add the aircraft heater to Surface Combustion's long-established peacetime lines of industrial furnaces and Janitrol gas furnaces and burners for homes, stores, and factories will be welcomed by the plane manufacturers and commercial air lines.

THOS. H. BEAN OPENS NEW CONSULTING OFFICE

Thomas H. Bean has opened offices at 813 Hidalgo St., New Orleans 19, La., in the mechanical and electrical fields. He is a graduate of the University of Illinois, and for nearly 10 years has specialized in air conditioning, refrigeration, and ventilation in the commercial, industrial, and residential fields.

New York Welcomes ASHVE January 27-30

The Empire State Building

THE SOCIETY will hold its 52nd Annual Meeting at the Hotel Commodore, New York, January 28-30, 1946, and plans have been completed by the Committee on Arrangements to welcome the members who will attend from all parts of the country.

Registration will commence on Monday, January 28, at 9:00 a.m., and during that morning and the preceding day, the Council and a number of Committees will hold meetings.

The first function for everyone is the Welcome Luncheon at noon on January 28, in the East Ballroom of the Commodore, with R. H. Carpenter as toastmaster. The speaker will be Harvey Wiley Corbett, prominent New York architect, whose subject will be "Are We Over-Mechanizing Life?"

The first business session will be opened by Pres. C.-E. A. Winslow at 2:00 p.m., and at this meeting the greetings of the New York Chapter will be given by Pres. Harold J. Ryan. The reports of Officers and Council will be presented and other important subjects for discussion will be the revision of the Society's Charter, consideration of the new Nominating Committee procedure, voted at the last Annual Meeting, and amendments to the Constitution and By-Laws involving finances and other administrative matters.

During the afternoon the Nominating Committee will hold its meeting, and in the evening the Past Presidents will have their annual dinner, while the other members and guests will enjoy an informal Mardi-Gras Party with dinner and carnival in the Hotel Capitol, 51st St. at 8th Ave. A lavish revue will be staged by John Murray Anderson. The Entertainment Committee has prepared an unusual program for this occasion, and Prof. M. C. Giannini, the chairman, desires to make this an outstanding party.

Three technical sessions are scheduled for Tuesday and Wednesday morning, and the papers cover a wide variety of subjects on fuels, heat transfer and several research reports on subjects of interest to members.

On Tuesday evening the annual banquet will be held in the Grand Ballroom of the Commodore, with W. H. Driscoll, past president of the Society, as toastmaster. The presentation of the Past President's emblem will be made to the retiring president. The F. Paul Anderson Medal will also be presented.

Early reservations for all of the functions, as well as for hotel rooms, are advisable.

The chapters have certified their delegates and members of the Nominating Committee.

There will be special entertainment for the ladies who attend and there will be several inspection trips arranged for the men. The Committee on Arrangements for New York Chapter is making every effort to provide an interesting and entertaining meeting and requests the cooperation of all members in making early reservation of tickets because of the present necessity for giving early commitments to hotel and other places of entertainment.

It is hoped that all who want to attend can be accommodated comfortably despite present crowded conditions of transportation and housing facilities.

Program

52nd Annual Meeting

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

January 27-30, 1946

Hotel Commodore — **New York, N. Y.**

Sunday, January 27

10:00 a.m. Meeting of Finance Committee (*Parlor E*)
10:00 a.m. Meeting of 1945 Committee on Research (*Parlor G*)
10:00 a.m. Meeting of Committee on Code for Testing Heavy Duty Furnaces (*Parlor F*)
2:00 p.m. Meeting of Council (*Parlor G*)
2:00 p.m. TAC on Radiation and Comfort (*Parlor E*)

Monday, January 28

9:00 a.m. REGISTRATION (*West Ballroom Foyer*)
9:30 a.m. Meeting of Chapter Delegates (*Parlor A*)
9:30 a.m. TAC on Air Cleaning (*Parlor F*)
9:30 a.m. TAC on Glass (*Parlor E*)
9:30 a.m. TAC on Insulation
9:30 a.m. TAC on Sorbents
9:30 a.m. TAC on Air Distribution and Air Friction (Hotel Roosevelt—*Parlor O*)
9:30 a.m. TAC on Air Sterilization and Odor Control (Hotel Roosevelt—*Parlor L*)
9:30 a.m. TAC on Weather Design Conditions (Hotel Roosevelt—*Parlor M*)
10:00 a.m. TAC on Corrosion
10:00 a.m. TAC on Heating Load
12:15 p.m. Welcome Luncheon (*East Ballroom*)
Toastmaster: R. H. Carpenter
Speaker: Harvey Wiley Corbett
Subject: "Are We Over Mechanizing Life?"
2:00 p.m. BUSINESS SESSION (*West Ballroom*)
Greetings: H. J. Ryan, President, New York Chapter
Reports of Officers and Council Committees
Report on Revision of Charter
Report on Nominating Committee Amendment
Amendments to Constitution and By-Laws
Report of Tellers of Election
2:30 p.m. Ladies Card Party
4:30 p.m. Meeting of 1946 Committee on Research
4:30 p.m. Meeting of Nominating Committee (*Parlor A*)
6:30 p.m. Mardi-Gras Party—Dinner and Carnival in the Hotel Capitol, 51st St. at 8th Ave. A lavish Revue staged by John Murray Anderson
7:00 p.m. TAC on Cooling Load (*Parlor E*)

Tuesday, January 29

9:00 a.m. REGISTRATION (*West Ballroom Foyer*)
9:30 a.m. TECHNICAL SESSION (*West Ballroom*)
A Study of Several Coal-Fired Magazine-Feed Space Heaters, by R. C. Cross and H. N. Ostborg
Application of High Temperature Liquid as a Heat or Energy Transfer Medium for Domestic and Industrial Uses, by O. O. Oaks
A Single-Equation Design Procedure for Radiant Panel Systems, by F. W. Hutchinson
10:00 a.m. Inspection of Show Plant at Sheffield Farms
12:15 p.m. Meeting of Guide Publication Committee (*Parlor G*)
2:00 p.m. TECHNICAL SESSION (*West Ballroom*)
Low Pressure Properties of Water from —160 to 212 F, by John A. Goff and S. Gratch
Therapeutic Uses of Low Temperature, by Frederick M. Allen, M.D.
Heating and Ventilation of Transport Aircraft, by B. M. Brod
7:00 p.m. Annual Banquet (*Grand Ballroom*)
Toastmaster: W. H. Driscoll
Presentation of Past President's Emblem
Presentation of F. Paul Anderson Medal

Wednesday, January 30

9:30 a.m. TECHNICAL SESSION (*West Ballroom*)
Report of Committee on Research
Effect of Branch Take-Off Design on Noise in Ventilating Duct Systems, by Oscar Imalis, F. C. Houghten and C. M. Humphreys
Physiological Response of Subjects Exposed to High Effective Temperatures and Elevated Mean Radiant Temperatures, by C. M. Humphreys, Oscar Imalis and Carl Gutberlet
An Experimental Investigation of the Effect of Change in Atmospheric Conditions and Noise Upon Performance, by Morris S. Viteles, Ph.D., and Kinsley R. Smith, Ph.D.
Shielding of Thermocouples from the Effects of Radiation, by G. V. Parmelee and R. G. Huebscher
Unfinished Business
New Business
Installation of Officers
Adjournment
12:30 p.m. Council Luncheon Meeting (Hotel Commodore—*Parlor A*)

NOMINEES FOR COUNCIL

THREE-YEAR TERM

Earl G. Carrier, Boston, Mass., was born on December 19, 1905 at Buffalo, N. Y. He attended Montclair High School at Montclair, N. J., and was graduated from the University of Wisconsin in 1928 with a degree of B.S. in mechanical engineering.

Earl G. Carrier

Mr. Carrier has specialized in designing and supervising engineering work, with many years experience in air conditioning, heating and refrigeration in the industrial, domestic and commercial fields.

In August 1929 he became associated with the General Electric Co., Schenectady as test engineer at their research laboratory.

He joined the staff of Carrier Corp. in April 1929 as an estimating and sales engineer, where he supervised the field work and testing, estimating for domestic and foreign applications. Among them are many installations in the United States, Africa, and South America.

Mr. Carrier first joined the Society in 1929 as a junior member and became a member in 1936, and since his association with the Society has taken an active interest in the affairs of the Massachusetts Chapter. He served as its secretary-treasurer in 1941, and as president of the Chapter in 1942 and 1943, and was Chairman of the Committee on Arrangements for the 51st Annual Meeting in Boston in January 1945.

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F. W. Hutchinson, Berkeley, Calif., was born on April 7, 1910, at Suijun City, Calif. He received his B.S. from California Institute of Technology in 1931. He received his M.S. and M.E. degrees from the University of California.

He spent five years as construction inspector for the C. & H. S. R. Co. at Crockett, and three years as mechanical engineer in designing automatic control equipment. He has also spent some time as instructor in refrigerating and air conditioning at the University of California.

He joined the Society in 1937 as an Associate Member and became a Member in 1942. He has served as a member of the Research TAC on Radiation and Comfort for a number of years.

Professor Hutchinson accepted appointment as professor of mechanical engineering at Purdue University, Lafayette, Ind., effective July 1, 1945. He was associate professor of mechanical engineering at the University of California for eight years, where he started as a graduate student.

F. W. Hutchinson

He is the author or co-author of over 35 papers, articles and reference book contributions, including publications in journals of the *ASRE, British Heating and Ventilating Institute, Institute of Aeronautical Sciences, AIEE, NDHA, HPACCNA, Pacific Coast Gas Association,* as well as many papers published in the Society's JOURNAL and TRANSACTIONS.

Professor Hutchinson is also a member of the *ASRE, IAS,* the Tau Beta Pi Engineering Society, the Sigma Xi and the *National Research Society,* and is listed in *Who's Who in Engineering.*

Ralph A. Sherman, Columbus, Ohio, Supervisor, Fuels Division, Battelle Memorial Institute, was born at Oskaloosa, Ia., on December 16, 1896. He was graduated from the University of Iowa in 1920 with an A.B. degree, and his first assignment was with the U.S. Bureau of Mines, Pittsburgh as fuel engineer. In this connection he carried out research work on combustion and heat transfer in domestic furnaces, steam power boilers, ceramic kilns, etc., and was in responsible charge of investigations from 1922 to 1930.

R. A. Sherman

He became associated with the Battelle Memorial Institute in 1930 and has won recognition as a leading authority on fuels.

Mr. Sherman joined the ASHVE in 1933 and has taken an active interest in Society affairs. He has served as chairman of the Research Technical Advisory Committee on Fuels from 1939 to date, and prior to 1939 served as a member of the committee.

Mr. Sherman has written several papers for the Society which have been presented at Society meetings and published in its TRANSACTIONS.

He is also a member of the *ASME, AGA,* and the *American Society for Testing Materials.*

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M. S. Wunderlich, General Sales Manager, Insulite Div., Minnesota and Ontario Paper Co., was born at Faribault, Minn. on March 11, 1891. He attended the Ellsworth Academy, Iowa Falls, Ia., and was graduated from the University of Minnesota with a degree of B.S. in mechanical engineering.

He joined the staff of the Flaxlinum Insulating Co., St. Paul, in 1920, and held various positions in research and production, and served as a member of its Board of Governors and Assistant to the President and General Manager from 1926-1929. Since 1932 he has been associated with the Minnesota and Ontario Paper Co., as research engineer, and special assignments on product development. In 1935 he went to Europe as consultant to the European Insulite organization, studying European products, construction, and manufacturing pos-

M. S. Wunderlich

sibilities. He became head of research department in 1936, and was appointed to his present position in May 1942.

Mr. Wunderlich joined the Society in 1925, taking an active interest in the activities of the Minnesota Chapter. He served as its secretary-treasurer in 1928-1929, and on its Board of Governors from 1927-1930. He has served on several Chapter Committees, as well as on the Society's Nominating Committee in 1931 and 1935, and as a member of the Guide Publication Committee in 1939.

Mr. Wunderlich is also an active member of the *ASME* and a registered professional engineer of Minnesota.

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SUMMARY OF LOCAL CHAPTER MEETINGS

CONNECTICUT—November 14. Subject: Forced Circulation Hot Water Heating. Speaker: Frank C. Hackett, Southern Dist. Mgr., Bell and Gossett Co., Washington, D. C. Mr. Hackett's talk was illustrated and proved an interesting feature of the meeting. Other Features: Prof. M. L. Wiedman, Yale University, was introduced and welcomed on his return as a professor of mechanical engineering. Col. William Amelon was also introduced. Treasurer Julius Smak reported on the financial status of the chapter. A motion was made and unanimously adopted to elect Prof. L. E. Seeley as an Honorary Member of the Connecticut Chapter, in recognition of his work as the first President of the Chapter and as a member since its organization. Professor Seeley was recently appointed Dean of the College of Technology, Durham, N. H. Pres. Hart announced that the 52nd Annual Meeting of the Society was to be held in New York, January 28-30, with headquarters at the Hotel Commodore, and urged all the members to attend. Attendance 77. Attendance ratio, 1.6.

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DELTA—November 12. Subject: Air Conditioning Controls. Speaker: R. M. Spencer, Branch Mgr., The Powers Regulator Co., Chicago, Ill. Mr. Spencer gave an interesting presentation with slides, followed by a lively discussion from the floor. This was a joint meeting with the Louisiana Engineering Society, and R. A. Steinmayer, president of that Society, called the meeting to order. The meeting was then turned over to W. H. Grant, Jr., president of the Delta Chapter, who announced the Chapter-Nominating Committee meeting. Attendance, 18. Attendance ratio, 0.35.

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GOLDEN GATE—November 13. Subject: The Air Cooled Human Body. Speaker: Dr. C.-E. A. Winslow, Dir., John B. Pierce Laboratory of Hygiene and President of ASHVE, New Haven, Conn. Dr. Winslow stated that among other things metabolic processes that produce heat in the body make it necessary to have air conditioning, and it is not a question of the air we breathe, but of that which bathes the skin. He pointed out that there were three major factors affecting body comfort, convection, radiation and evaporation. If the body is producing heat faster or slower than it loses or gains it, Dr. Winslow stated that storage is required. Slides were shown of the methods and results of experiments on human subjects. After his talk, Dr. Winslow answered many questions from the audience. As reported by the chapter secretary, his talk was most interesting and was thoroughly enjoyed by all present. Other Features: Pres. R. B. Holland introduced the guests, among whom were, Dr. J. C. Geiger, Dir., Department of Public Health, San Francisco, Dr. Walter A. Brown, University of California, School of Public Health, San Francisco, Dr. Robert T. Legge, University of California, Berkeley, Dr. Charles E. Smith, Stanford Medical School, San Francisco, and Mr. L. M. Hausman, Manila, P. I. Following the introductions the meeting was turned over to Dr. B. M. Woods, first chapter president and member of the Society's Council, who told of the Society's Research Laboratory and collaboration with medical societies. Attendance, 66. Attendance ratio, 0.78.

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INDIANA—December 7. Subject: Chemical Research Development in Plastics. Speaker: V. S. Peterson, consultant of DuPont's Extension Division. Pres. G. B. Supple called the meeting to order and urged all members to contact the Secretary of the Society if trained men are available for positions in the industry. President Supple also called attention to the 52nd Annual Meeting scheduled for New York, January 28-30, with headquarters at the Commodore. C. R. Ammerman, chairman of Membership Committee, reported as to the progress and aims of the committee. A short discussion was held in regard to the Indiana Chapter membership in the Indianapolis Technical Societies Council. Attendance, 45. Attendance ratio, 0.56.

MASSACHUSETTS—November 20. Subject: Cost Breakdown of Operation of Government Owned Projects Including Large and Small Boiler Plants. Speaker: A. D. Silverman, Deputy Assistant Commissioner for Project Management, Federal Public Housing Authority. Attendance, 30. Attendance ratio, 0.40.

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NORTH CAROLINA—November 16. Subject: Electronic Air Cleaning. Speaker: Arthur Nutting, Research and Design Engr., American Air Filter Corp., Louisville, Ky. H. J. Noles, Dist. Mgr., American Air Filter Corp., was introduced. Mr. Nutting's talk was well received and proved interesting and instructive. He used an electro air mat cell for one of his demonstrations. Other Features: The following were elected to serve on the Nominating Committee: W. M. Wallace, II, chairman; W. D. Graham, R. B. Rice, C. Z. Adams and Harry Hoffman. Attendance, 41. Attendance ratio, 0.48.

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NORTH TEXAS—November 19. Subject: Psychology and the Thermostat. Speaker: F. C. McIntosh, Mgr., Pittsburgh office, Johnson Service Co. L. S. Gilbert, chairman of Nominating Committee offered the following nominations for 1946 officers: *President*—E. J. Stern; *Vice-President*—C. R. Gardner; *Secretary-Treasurer*—B. S. Foss, Jr. *Board of Governors*: J. A. Bishop, E. T. Gessell, H. L. Jones. Mr. Gessell and A. B. Ullrich, Jr. were elected as chapter delegates and alternate to the Society's Annual Meeting in New York. M. A. Benson, Branch Manager of the Johnson Service Co. in Dallas, spoke of his experiences on a Mediterranean cruise, before introducing the speaker of the evening. Attendance, 53. Attendance ratio, 0.91.

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ST. LOUIS—November 8. Subject: Radiant Heating. Speaker: Prof. F. W. Hutchinson, Purdue University, Lafayette, Ind. Pres. W. J. Oonk introduced the speaker, who explained in detail the research work that has been done to date on this subject. He drew a line of distinction between radiant heating and a combination of panel and convection heating, which is commonly used and called radiant heating. Without having any controversial difference of opinion with sales engineers engaged in designing and selling panel and radiant heating, Professor Hutchinson explained many of the mistaken ideas about the exaggerated claims for radiant heating. After an interesting period of general discussion, during which Professor Hutchinson answered several questions, President Oonk thanked the speaker on behalf of the St. Louis Chapter and the Engineers' Club of St. Louis for his splendid talk. Other features: H. C. Sharp, chairman of the membership committee, reported on the activity of his committee, and invited all of the members to actively work with his committee in building up the St. Louis Chapter membership. Attendance, 225.

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WESTERN NEW YORK—November 27. Subject: Housing Research—An Aid to Heating and Air Conditioning. Speaker: Carl F. Boester, Housing Research Executive, Purdue Research Foundation, Purdue University, Lafayette, Ind. Professor Boester scored a distinct hit with his introductory remarks about the ASHVE and what he has gained through his membership in the Society and his association with the fine men connected with it. Professor Boester then launched into his program with his picturization of the *House of Tomorrow* and the *Opportunity for Youth*, which the Western New York Chapter will long remember. The secretary of the Chapter reported that Professor Boester has a great educational story which he puts over with a bang. Attendance, 26. Attendance ratio, 0.38.

Note. The attendance ratios shown above represent the meeting attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

PAUL McDERMOTT DIES SUDDENLY

Members and friends of Paul McDermott, Section Head in Charge of Insulation, Development Research Laboratory, Johns-Manville Corp., Manville, N. J., will be shocked to learn of his sudden passing on December 18, 1945. Mr. McDermott died of a heart attack while in Cleveland on a business trip.

Mr. McDermott, although he joined the ASHVE in 1943, has long been associated with Society affairs, having been Research Physicist at the Society's Research Laboratory for five years, when it was located in Pittsburgh under the direction of the late Ferry C. Houghten. As a member of the staff he worked out problems of heat transmission, particularly through building materials, air films and as influenced by solar radiation. He also spent some time studying heat losses from pipes and heat and moisture losses from human bodies, as well as garage ventilation, particularly the removal of carbon monoxide.

He joined the staff of the Johns-Manville Research Laboratory in 1933 as Research Physicist, advancing to Research Engineer, and later to Section Chief in Charge of Development Work on Low Pressure Insulation. He designed and constructed emissivity apparatus and operated this equipment in connection with all types of thermal insulations, and was in charge of a section of the Laboratory handling all physical tests on thermal insulations manufactured by the corporation, and all competitors.

Paul McDermott

Mr. McDermott was appointed a member of the Guide Publication Committee in 1945, and also served for several years on Research Technical Advisory committees.

He will be greatly missed by a host of friends in the profession and by his many associates in the Society.

The Officers and Council of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS extend their deepest sympathy to his widow and sisters who survive.

ANNOUNCEMENT OF 1947 EVENTS

53rd Annual Meeting ASHVE

7th International Heating & Ventilating Exposition

Cleveland, Ohio – January 1947

THE 53RD Annual Meeting of the ASHVE will be held in Cleveland, Ohio, during the 4th week of January 1947, according to an announcement by Pres. C.-E. A. Winslow. Coincident with the Society's Meeting, the 7th International Heating and Ventilating Exposition will be held at Lakeside Hall, Cleveland, January 27-31.

The central location of Cleveland for this first post-war heating, ventilating and air conditioning exposition will bring together the results of seven years of industrial development and research in this industry.

Not since 1940 has the profession and industry had an opportunity of seeing an all-industry exhibit of this kind, and it is anticipated that the 7th will be one of the largest expositions of its kind. It will illustrate vividly the manner in which the heating, ventilating and air conditioning industry is prepared to serve peace-time needs.

As in the past, the exposition will be managed by International Exposition Co., Grand Central Palace, New York, with Charles F. Roth as manager, and E. K. Stevens as associate manager.

Later announcements will give detailed plans for both the Meeting and the Exposition.

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the Journal of the Society or sent to the members in other approved manner as ordered by the Council. When replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 24 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by January 31, 1946, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

AITKEN, THOMAS, Estimator, Sauer Co., Inc. PROPOSERS: H. R. Allonier, A. W. Williams. SECONDERS: J. D. Slemmons, Joseph Zellak.

ARANDA, ARTURO, Engr., Departmento de Hidraulica-Morande. PROPOSERS: C. P. Yaglou, Philip Drinker. SECONDERS: C. A. Berry*, G. W. Fair*.

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Candidates Elected

In the past issues of the Journal of the Society the names of the following men were listed as Candidates for Membership. The membership grade of each Candidate has been assigned by the Committee on Admission and Advancement and balloted upon by the Council. We are now instructed by the Council to post herewith, as required by Art. B-III, Sec. 8, of the By-Laws, the following list of candidates elected:

Members

BABCOCK, DAN, Plant Engr., Allison Div., General Motors Corp., Indianapolis, Ind.

BELSKY, GEORGE A., Chief Engr., Majestic Refrigerator Corp., New York, N. Y. (*Reinstatement & Advancement*).

BRUEN, ROBERT, Htg. Contractor, Oakland, Calif.

CHRISTIERSON, CARL A., Mgr. & Chief Engr., Air Conditioning & Engineering Co., Durban, South Africa. (*Advancement*).

DELALANDE, ANDRE, Cons. Engr., Paris, France.

DOME, ALAN G., Sun Shipbuilding & Dry Dock Co., Chester, Pa. (*Advancement*).

ELLIOTT, JAMES H., Wright Field, Dayton, Ohio.

FEINBERG, EMANUEL, Pres., American Thermal Industries, Inc., Detroit, Mich. (*Advancement*).

GOODWIN, WALTER C., Negotiation Mgr., Air Cond. Div., Westinghouse Electric Corp., Jersey City, N. J.

HAMER, FRED S., Design Engr., Surface Combustion Corp., Columbus, Ohio.

LONGWORTH, A. L., Asst. Fuel Engr., Ministry of Fuel & Power, Manchester, England.

MEHAFFEY, ROBERT V., Cons. Engr., Chicago, Ill.

OREBAUGH, HOWARD T., Application Engr., York Corp., Seattle, Wash.

PATTEN, J. ELVERTON, Engr., B. Offen & Co., Chicago, Ill.

RUNGE, NATHAN P., Sales Engr., Garden City Fan Co., Chicago, Ill.

SCHIWETZ, DAVID P., Branch Mgr., York Corp., Charlotte, N. C.

SELVING, HOLGER T., Mech. Engr., Fisher Body Div., Works Engrg. Dept., Detroit, Mich.

SKAGGS, GEORGE E., Staff Engr., Donald R. Warren Co., San Francisco, Calif.

SMALL, ALEX G., Assoc. Htg. Engr., Los Angeles City Board of Education, Los Angeles, Calif.

VAN ZELM, HENRI B., Cons. Engr., Hartford, Conn.

WILSON, BROADUS, Pres., General Air Conditioning Co., Raleigh, N. C.

Associates

ARNOLD, THOMAS L., Mgr., Vulcan Radiator Co., Hartford, Conn.

BEGOON, GEORGE F., Mgr., Precipitron Dept., Westinghouse Electric Corp., Jersey City, N. J.

BISBEE, BERTIN A., Partner, L. E. Smith Hardware Co., Marshall, Minn.

BOWEN, J. P., Branch Mgr., Penn Electric Switch Co., Atlanta, Ga.

BOYER, CHARLES T., Engr., Servel Inc., Evansville, Ind.

BRENTON, REGINALD S., Partner, Brenton & Hart, Boston, Mass.

CHEWNING, RAY C., Asst., J. Donald Kroeker, Portland, Ore.

CHYTRAUS, OSCAR E., Mfrs. Agent, Salt Lake City, Utah.

CLARK, D. L., Air Cond. Teacher, Bremerton High School, Bremerton, Wash.

CULVER, FRANK C., Mfrs. Repr., Day & Night Manufacturing Co., Seattle, Wash.

DUGGER, EARL R., Chief Engr., Oklahoma Refrigerating Co., Oklahoma City, Okla. (*Reinstatement*).

GODFREY, THEODORE R., Partner, F. H. Godfrey Engineering Co., Seattle, Wash.

GRAHAM, WILLIAM A., Prod. Engr., Reid Hayden Inc., Charlotte, N. C.

HARRISON, PAUL N., Owner, Paul N. Harrison Co., San Francisco, Calif.

HERKIMER, HAROLD, Engr., Raisler Corp., New York, N. Y.

HOVDA, ARTHUR F., Htg. Inspector, City of Minneapolis, Minneapolis, Minn.

KINCAID, W. V., Dist. Engr., Pittsburgh Lectro Dryer Corp., Chicago, Ill.

KUCK, THEODORE A., Field Engr., South Side Hardware & Plumbing Co., Sheboygan, Wis.

MCMULLEN, C. S., Student Air Cond. Engr., The Trane Co., La Crosse, Wis.

MILES, OSCAR K., Mech. Engr., General Engineering Co., Fort Worth, Tex.

NICKERSON, ALBERT E., Engr., Asbestos Supply Co. of Seattle, Seattle, Wash.

OLSSON, ERIC V., Field Engr., B. F. Sturtevant Co., Hartford, Conn.

PATERSON, ROLLIN O., Estimator, Fisher Body Div., General Motors Corp., Detroit, Mich.

POOLE, JOE A., Dallas Air Conditioning Co., Dallas, Tex.

PRIDE, WILLIAM B., Field Engr., Boeing Airplane Co., Renton, Wash.

REYNOLDS, JOHN F., Vice-Pres., Stokley's Services Inc., Norfolk, Va.

RILEY, EDWARD F., Vice-Pres., Palmer Supply Co., Seattle, Wash.

SAAR, L. F., Gen. Supt., Htg. & Air Cond. Dept., Brizard Co., San Francisco, Calif.

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SHIPP, WILLIAM H., Application Engr., Minneapolis-Honeywell Regulator Co., Boston, Mass.

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STRONG, STEWART S., Sales Engr., Parsons Engineering Corp., Cuyahoga Falls, Ohio.

SWALLOW, J. H., Mgr., Bryant Heater Co., St. Louis, Mo.

TOWNE, C. O., Sales Engr., Clowe & Cowan, Inc., Amarillo, Tex. (*Reinstatement*).

TRIOL, EDWARD W., Draftsman, C. W. May, Seattle, Wash.

WALSH, T. A., Chief Engr., U. S. Naval Air Station, Glenview, Ill.

WARREN, HAROLD F., Sales Engr., R. E. Chase & Co., Tacoma, Wash.

WESTBROOK, CHARLES H., Partner, American Plumbing & Heating Co., Oklahoma City, Okla.

WILLIAMS, H. O., Field Service Engr., A. M. Byers Co., Houston, Tex.

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COLE, VICTOR, Engr., Carrier Corp., New York, N. Y.

ENGLISH, R. B., Ensign, U. S. Naval Reserve, Davisville, R. I.

MALLIK, J. R. B., Student, Massachusetts Institute of Technology, Cambridge, Mass.

Student

ROYCE, ROBERT F., Graduating Sr. Mech. Engrg. Student, University of Michigan, Ann Arbor, Mich.

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F. Paul Anderson Award: A. J. Offner, *Chairman;* W. H. Carrier, F. E. Giesecke, W. L. Fleisher, F. B. Rowley.

Guide Publication: C. S. Leopold, *Chairman;* W. C. Bevington, R. S. Dill, C. F. Kayan, A. B. Newton, Cyril Tasker, G. H. Tuttle, T. F. Rockwell, W. L. Yerkes.

Publication: L. E. Seeley, *Chairman* (*one year*); J. C. Fitts (*two years*); W. E. Heibel (*three years*).

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18. **Radiation and Comfort:** J. C. Fitts, *Chairman;* R. E. Daly, Dr. F. E. Giesecke,* L. N. Hunter, Prof. F. W. Hutchinson,* John James,* Prof. A. P. Kratz, C. S. Leopold, E. M. Mittendorff, L. L. Munier, Dr. G. W. Penney, H. F. Randolph, W. R. Rhoton.

19. **Sensations of Comfort:** Thomas Chester, *Chairman;* R. S. Arnold, Prof. M. K. Fahnestock, G. D. Fife, Lt. Col. W. J. McConnell, F. C. McIntosh,* A. B. Newton, K. E. Robinson, Prof. C. P. Yaglou.

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21. **Sound Control:** R. D. Madison, *Chairman;* C. M. Ashley,* Dr. P. H. Geiger, C. H. Hall, W. W. Kennedy, G. C. Kerr, E. W. McMullen, A. G. Sutcliffe, T. H. Troller, Capt. T. H. Urdahl,* Dr. T. A. Walters.

22. **Weather Design Conditions:** Capt. T. H. Urdahl,* *Chairman;* J. C. Albright, C. E. Bentley, R. E. Biller, H. S. Birkett, J. F. Collins, Jr., Lt. Comdr. John Everetts, Jr., J. P. Fitzsimons, Capt. J. D. Kroeker, Comdr. F. W. Reichelderfer, H. C. S. Thom.

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Central New York: Organized, 1944. Headquarters, Syracuse, N. Y. President, C. M. Ashley, 300 S. Geddes St., Syracuse 1. Secretary, F. E. Hockensmith, 400 N. Midler Ave., Syracuse.

Central Ohio: Organized, 1944. Headquarters, Columbus, Ohio. Meets, Third Monday. President, A. W. Williams, 5 E. Long St., Rm. 808, Columbus 15. Secretary, H. R. Allonier, 101 N. High St. Columbus 15.

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New York: Organized, 1911. Headquarters, New York, N. Y. Meets, Third Monday. President, H. J. Ryan, 101 Park Ave., New York 17. Secretary, Carl H. Flink, Room 3000, 51 Madison Ave., New York 10.

North Carolina: Organized, 1939. Headquarters, Durham, N. C. Meets, Quarterly. President, K. W. Selden, Jr., 701 Builders Bldg., Charlotte 2. Secretary, E. S. DeWitt, 1211 Commercial Bank Bldg., Charlotte.

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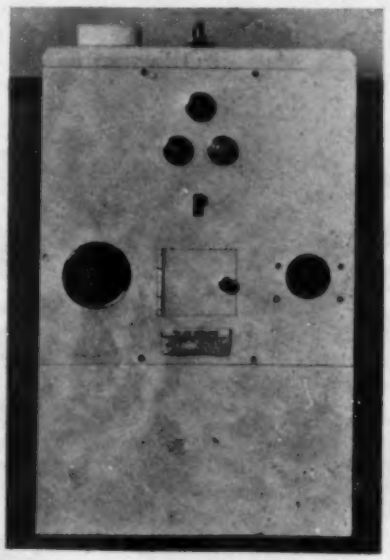

The air conditioning units, operating on the principle of chemical dehumidification, are designed to provide independent control of temperature and humidity. The chemical used to accomplish dehumidification is triethylene glycol which also has a germicidal effect on air-borne bacteria. It is said that tests conducted during the war in cooperation with the Army and the Navy establish the fact that the presence of a minute quantity of this chemical vapor in the air reduces sharply the incidence of pneumonia, streptococcus, influenza, and the common cold. One of the war time uses of these vaporizers was in the production of penicillin in order to free the air of germs which might interfere with the penicillin culture.

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[*Continued on page* 208]

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18. **Radiation and Comfort:** J. C. Fitts, *Chairman;* R. E. Daly, Dr. F. E. Giesecke,* L. N. Hunter, Prof. F. W. Hutchinson,* John James,* Prof. A. P. Kratz, C. S. Leopold, E. M. Mittendorff, L. L. Munier, Dr. G. W. Penney, H. F. Randolph, W. R. Rhoton.

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20. **Sorbents:** Lt. Comdr. John Everetts, Jr., *Chairman;* R. E. Cherne, O. D. Colvin, F. C. Dehler, L. S. Epstein, Dean John A. Goff,* C. H. B. Hotchkiss, J. C. Patterson, G. L. Simpson, C. F. Sines.

21. **Sound Control:** R. D. Madison, *Chairman;* C. M. Ashley,* Dr. P. H. Geiger, C. H. Hall, W. W. Kennedy, G. C. Kerr, E. W. McMullen, A. G. Sutcliffe, T. H. Troller, Capt. T. H. Urdahl,* Dr. T. A. Walters.

22. **Weather Design Conditions:** Capt. T. H. Urdahl,* *Chairman;* J. C. Albright, C. E. Bentley, R. E. Biller, H. S. Birkett, J. F. Collins, Jr., Lt. Comdr. John Everetts, Jr., J. P. Fitzsimons, Capt. J. D. Kroeker, Comdr. F. W. Reichelderfer, H. C. S. Thom.

*Member of Committee on Research.

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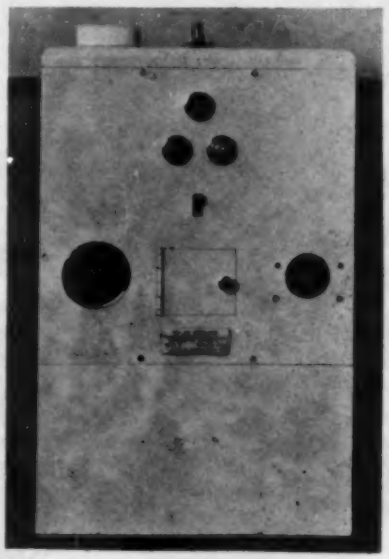

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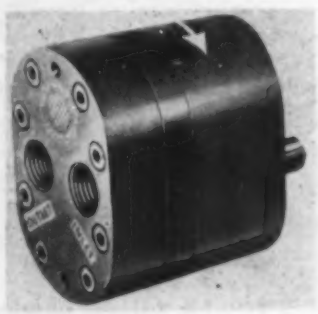

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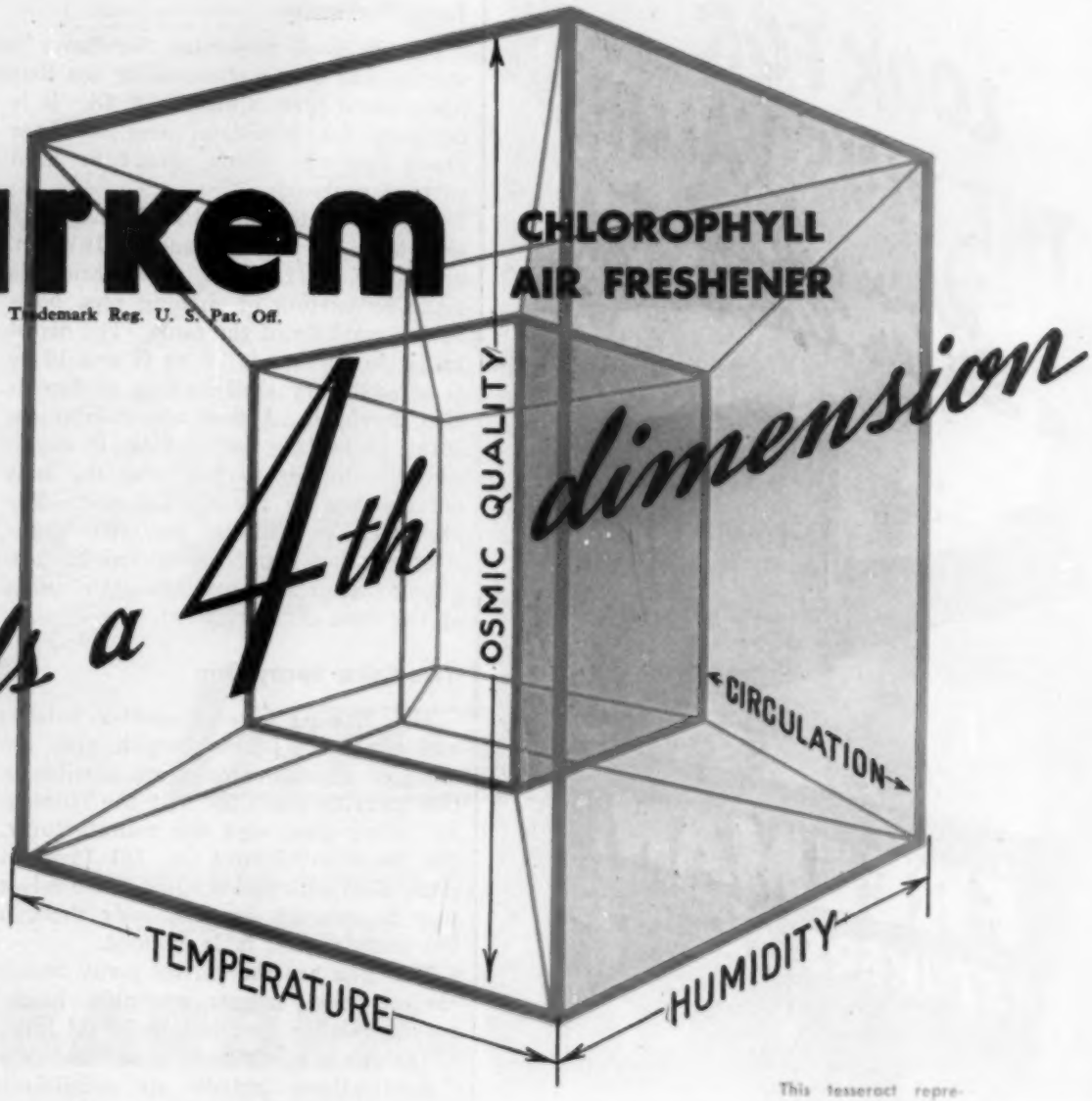

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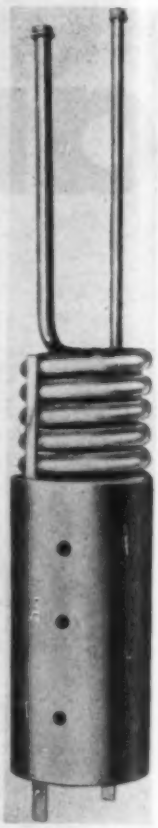
FREEMAN STOKER DIVISION
ILLINOIS IRON & BOLT CO.
918 S. MICHIGAN AVENUE, CHICAGO 5, ILLINOIS

[*Continued from page* 199]

Tank Preheater

No. 2965—A preheater for heavy liquids in bulk storage has been announced by the Rempe Co., 362 N. Sacramento Blvd., Chicago 12, Ill. It is designed for industrial uses of lower grade fuel oils which cannot be used without preheating.



This preheater can be made to fit any size tank having a manhole 16½ in. or larger, it is said. Installation is made by cutting or drilling pipe holes in the manhole of the tank. The direct radiation surface is 30 sq ft and 10 sq ft of secondary shell heating surface is also provided. A flow accumulator assures preheating by making it necessary for liquids to flow over the coils before entering the suction line. The preheater is built for use with either steam or hot water as desired by providing proper size inlet and outlet pipes at the time of fabrication.

Two Color Spray Gun

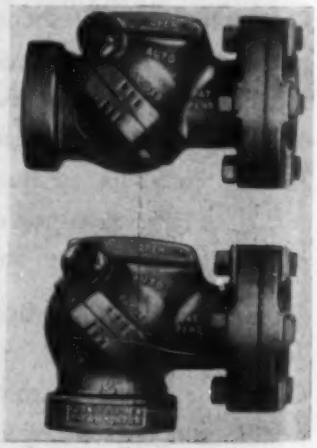
No. 2966—Two coat spatter finishes and simulated finishes which give the effect of iridescent metal are possible in one spraying operation with the "Dimenso" spray gun, says the manufacturer, the Sherwin-Williams Co., 101 Prospect Ave., N. W., Cleveland, Ohio. Two colors may be sprayed simultaneously through the same nozzle, it is claimed.

This gun has the normal spray fan control and fluid control valve, trigger assembly, head, fluid tip, and needle. It has an additional fluid inlet near the head of the gun to accommodate the second color paint.

Applications include air conditioning equipment, stokers, oil burners, recording instruments, and electric fans.

Adjustable Hot Water Flow Control Valve

No. 2967—A flow control or check valve, for hot water heating systems, that may be mounted in either a vertical or horizontal position, or used as an angle valve, is offered by the Triplex Heating Specialty Co., 252 N. Grant, Peru, Ind. The valve seat and cover casting are made in two sections—divided at a 45 deg angle—and are held together by four socket headed cap screws. An external control knob permits the valve to be opened by hand. Valves are furnished in sizes from 1 in. to 3 in., inclusive.



Sidewall application combined with cove lighting
High-ceiling application of continuous LINE-O-FLO outlets
LINE-O-FLO combined with glass panels in a continuous light strip

line-o-flo

PATENT APPLIED FOR

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BARBER-COLMAN COMPANY • 1228 ROCK STREET, • ROCKFORD, ILLINOIS

Continuous LINE-O-FLO combined with fluorescent light strip
LINE-O-FLO alternated with standard fluorescent fixtures, arranged for supply only or supply-and-exhaust

The public "goes for" these latest improvements

—in new Type 10 Mueller Gas Boilers:

New design for better performance. New styling for better appearance. New, exceptionally quiet burner. Many other modern features that win acceptance with your customers. Backed by the performance record of a long-time leader in gas-heating progress. Make easier sales and protect your reputation by promoting Climatrol Gas Boilers. Ask for Facts & Figures Bulletin F-320 giving full details.

L. J. Mueller Furnace Company

2007 W. Oklahoma Ave. Milwaukee 7, Wis.

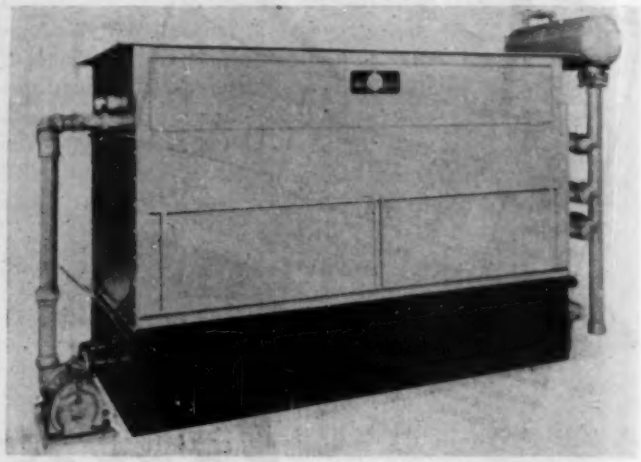
E-21

Climatrol

REG. U. S. PAT. OFF.

Liquid Cooler

No. 2968—Announcement has been made of an improved liquid cooler for furnishing refrigerated cooling water or any aqueous solution for industrial uses. The unit is said to be particularly adapted to furnishing cooling water just above the freezing point. In addition to uses in air conditioning and water cooling jackets, it is said to play an important part in chemical, photographic, and other industrial processes as well as in milk plants, bakeries, and other food industries.

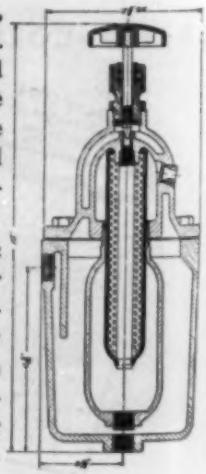


The method used is to spray the cooling water over banks of coils in which the refrigerant is expanded. The water falls into a tank and is recirculated independently of the distributing system. By means of a newly developed coil arrangement and design, the manufacturer claims capacity increases of 50 to 100 per cent over the company's previous models of similar sizes. As a result, greater compactness, capacity, and rapidity of cooling, as well as temperature control, are claimed.

The capacities of different sizes run from 4.7 to 137 tons with water deliveries ranging from 11 to 220 gpm. To provide temperatures below freezing, the coolers may be operated with a "No Frost" solution and special provision has been made for the application of insulating materials. The unit is manufactured by the Niagara Blower Co., 6 E. 45th St., New York 17, N. Y.

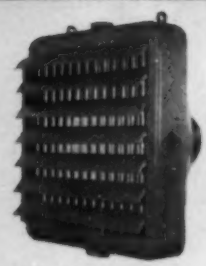
Steam Type Humidifier

No. 2969—Two new steam type humidifiers, utilizing a venturi nozzle to discharge steam, are now in production at the Armstrong Machine Wks., 874 Maple St., Three Rivers, Mich. One of the models has a solenoid valve to control automatically the flow of steam, while the other one (shown here) has a hand operated valve for manually controlled humidification.

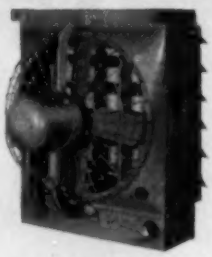


The venturi replaces an electric fan and motor used on the older models. Lower electrical load, thorough mixing of air and steam by virtue of fast discharge through the venturi, and simplification (elimination of fan and motor) are among the advantages claimed.

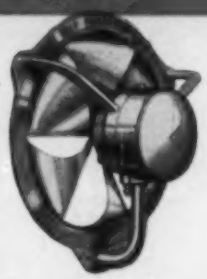
GUARANTEE COVERS BOTH MOTOR & FAN!



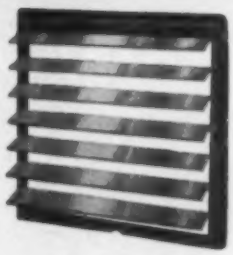
ILG STEAM OR HOT WATER UNIT HEATERS



ILG ELECTRIC UNIT HEATERS

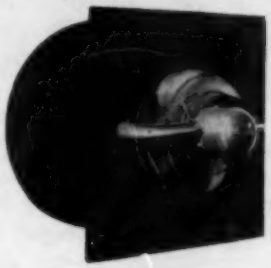


ILG SELF-COOLED MOTOR PROPELLER FANS

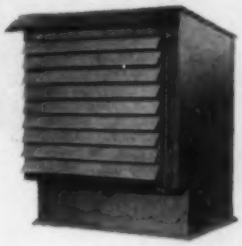


ILG AUTOMATIC SHUTTERS

ILG PORTABLE FANS FOR "MAN-COOLING" DUTY

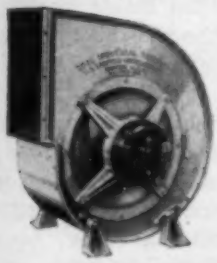


ILG DARK-ROOM VENTILATORS

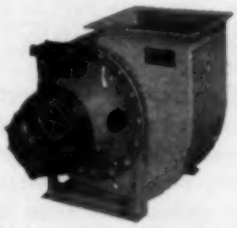


ILG POWER ROOF VENTILATORS

ILG "B" TYPE DIRECT-CONNECTED CENTRIFUGAL FANS

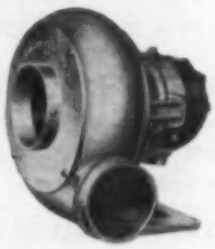


ILG "BC" TYPE DIRECT-CONNECTED CENTRIFUGAL FANS



ILG "CC" TYPE DIRECT-CONNECTED CENTRIFUGAL FANS

ILG "B" TYPE VOLUME CENTRIFUGAL FANS



ILG "P" TYPE VOLUME CENTRIFUGAL FANS

Every size, *every* type of ILG apparatus is covered by the famous "ONE-NAME-PLATE" Guarantee. Each product is warranted as a *complete unit* . . . including ILG-built motor —giving you assurance of *undivided responsibility!* Get latest data on these complete lines—write us or phone nearby Branch Office (consult classified directory).

FREE!

48-PAGE CATALOG AND DATA BOOK! Get latest information on the complete ILG line from this handy, vest-pocket size, well-indexed catalog and data book. It's yours for the asking.

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Without
MANUAL CLEANING OR
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CITY.....ZONE.....STATE.....

Flexible Tubing

No. 2970—A new type of flexible tubing, said to be non-collapsible under plus or minus pressures and retractable to about one eighth its extended length, has been announced by the Warner Brothers Co., Spiratube Div., Bridgeport, Conn., for portable or semi-permanent ventilation or any handling of air, gases or light solids. Its spring steel helix core causes it to spring out, like a jack-in-the-box, to its fully extended length, and it will stay in this position regardless of whether it is working on pressure or suction.

A feature of the "Spiratube" construction is the method of spiral-stitching the spring core within the fabric so that the inside surface is free of wire ridges. Sharp bends can be made without the use of elbows or special fittings.

The tubing is considerably lighter than metal duct or molded tubing, and takes up less space when retracted, says the manufacturer. The standard tube is made of long fiber duck, having a bursting strength of 170 psi; the fabric is processed fire-resistant and covered with thermoplastic. It can also be made to specification in a variety of other fabrics for special applications. Spiral stitching is done with a double seam of rot-proofed thread. There is no exposed metal inside or out, and this feature is said to eliminate the possibility of sparking where explosive or inflammable materials are present.

The product has been used in shipyards, vessels, and advance bases, as well as in industrial applications such as removing dust and excess product in grinding operations, removing sawdust and wood chips in woodworking, grain and flour milling and conveying, handling paper waste trim, removing welding fumes, and in mining other than coal.

This flexible tubing is furnished in standard diameters from 3 to 16 in., and in lengths of 10, 15, and 25 ft. Built-in couplings are provided for joining or disconnecting.

Nine Per Cent Nickel Steel Available for Tubing

No. 2971—A new application of the recently developed 9 per cent nickel steel in tubing designed especially for subzero temperatures has been announced by the Babcock and Wilcox Tube Co., Beaver Falls, Pa., manufacturers of the product. This is said to be the first time that this high nickel-bearing steel has been made available in tubular form.

Developed primarily to answer the pressure tubing needs of plants handling liquified gases or other low temperature fluids, the new nickel steel tubing is said to exhibit good physical properties even at temperatures as low as –320 F.

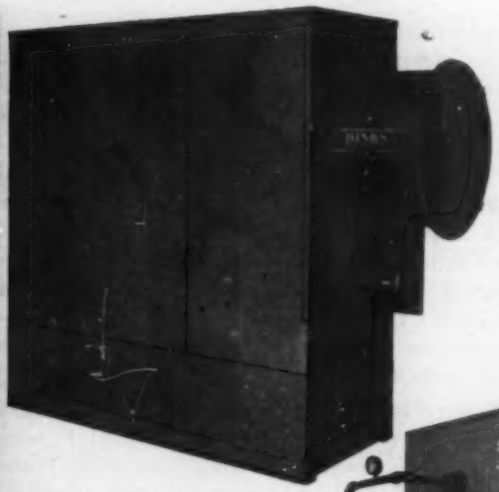
According to H. D. Newell, chief metallurgist and

[*Continued on page* 216]

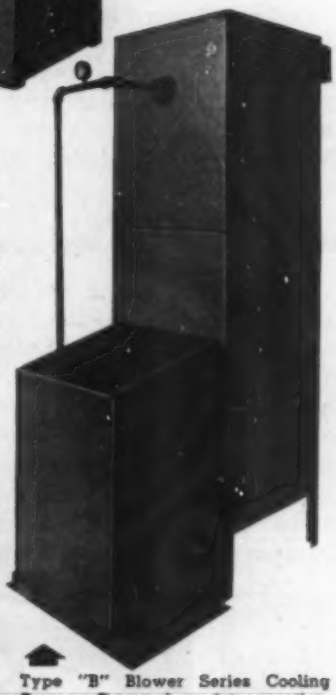
BINKS

COOLING TOWERS

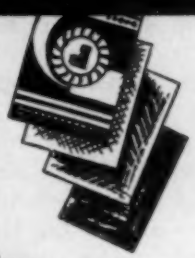
For Air Conditioning and Allied Industries



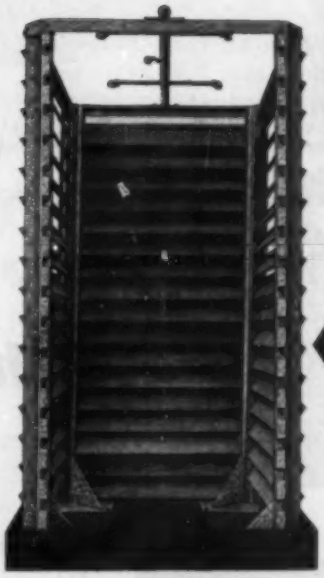
Binks 2-D series single fan horizontal towers are available in 6 standard frame sizes suitable for refrigeration loads up to 50 tons. Twin-fan towers of the same type are furnished in 5 frame sizes for loads up to 100 tons. All are suitable for indoor or outdoor operation as desired.



Type "B" Blower Series Cooling Towers. Extremely quiet operation.



Binks offers you a broad selection of shop prefabricated cooling towers to suit all air conditioning and industrial needs.



Type "S" Atmospheric Spray Cooling Towers.

Write for these Bulletins

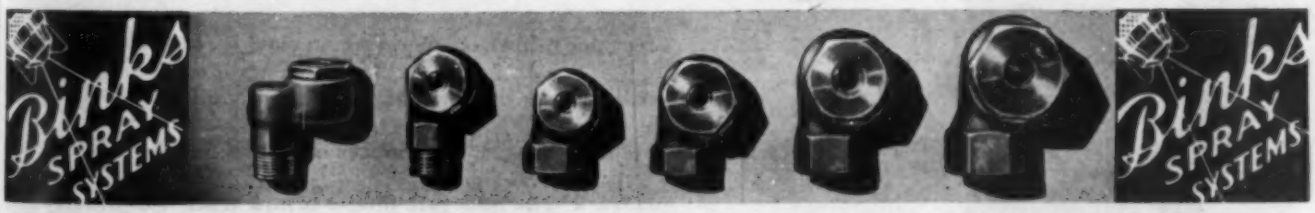
BULLETIN 800: Atmospheric spray cooling towers, single and multiple bay units. 30 standard sizes for refrigeration loads up to 240 tons.

BULLETIN 900: Vertical all steel induced draft towers. 24 standard sizes for loads up to 250 tons.

BULLETIN 700: Blower series forced draft towers for loads up to 20 tons. Extremely quiet operation. Ideally suited for packaged air conditioners.

BULLETIN 600: All steel horizontal induced draft towers for loads up to 100 tons.

BULLETIN 450: Spray nozzles of all types and sizes . . . full cone, hollow cone, and atomizing.



A COMPLETE LINE OF STANDARD SPRAY NOZZLES FOR ALL COMMON INDUSTRIAL APPLICATIONS

BINKS MANUFACTURING COMPANY
3114-40 Carroll Avenue, Chicago 12, Illinois
BRANCH OFFICES AND AGENCIES IN ALL PRINCIPAL CITIES

[*Continued from page* 212]

director of the company's laboratory, the new product may be applied in low temperature work as a substitute for 18-8 stainless steel tubing, and it will have particular applications in oil refineries and the chemical industries. It is also held probable that it can be used for special pump tubing in oil wells where salt water and hydrogen sulphide in the oil fluid present a difficult corrosion problem. Other applications are in the tubes for black liquor evaporation (in the preparation of waste black liquor for burning in the kraft paper industry), for caustic solution evaporation, and for alkaline-phenol solution work.

The new tubing is capable of giving Charpy impact values as high as 25 ft-lb, even at the —320 F temperature. It is claimed the new alloy will offer resistance to attack by alkaline media and to low temperature embrittlement to a greater degree than any other nickel alloy steel tubing regularly produced by the company.

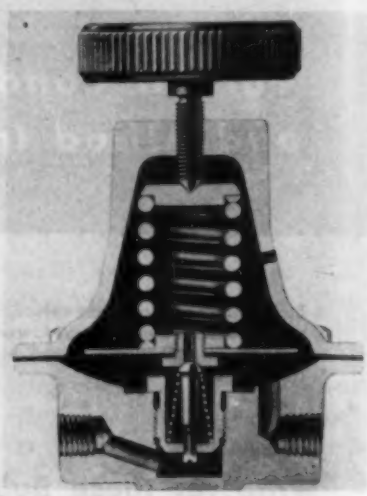
Electronic Pressure Measurement

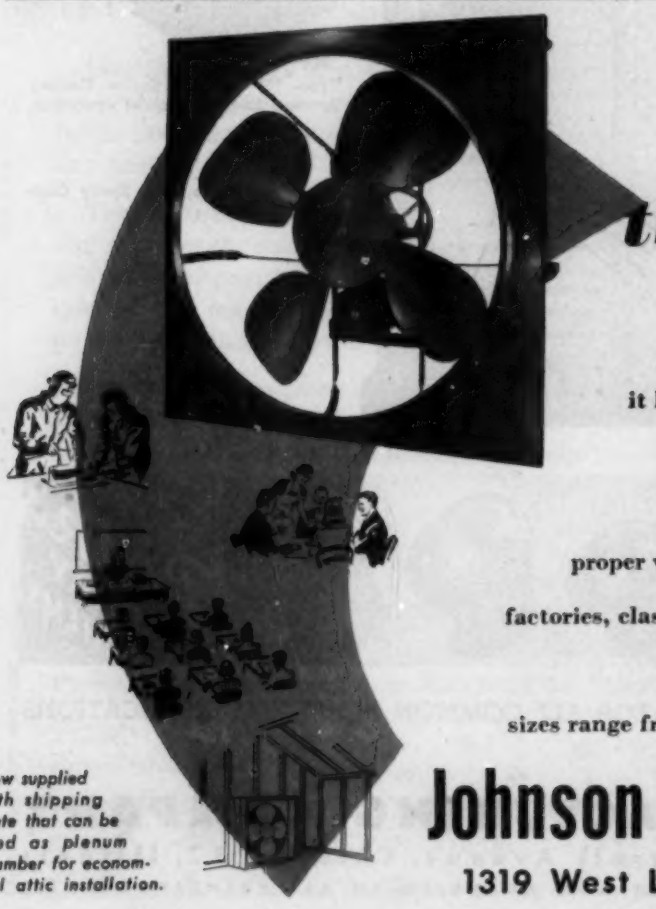
No. 2972—Utilizing the principle that the electrical characteristics of a wire filament change with a physical strain, the Baldwin Locomotive Works' Southwark division has developed the "SR-4 Pressure Sensitive Device," which is used to convert gas or liquid pressure to electrical energy for measuring, recording, or controlling. Its accuracy, 0.25 per cent of full scale having been consistently obtained, will mean that the device can be used for control operations that heretofore have not been possible, says the manufacturer. It is available in several ranges from 0 to 20,000 psi. Since it is essentially an electronic device it will enable results to be transmitted long distances whether for direct reading, recording, or control.

The heart of the device is a very fine filament wire bonded to a hollow metal core against which is exerted the gas or liquid pressure to be measured. As the pressure increases this filament stretches, thus changing the diameter of the wire and causing measurable changes in the electrical resistance of the wire.

Pneumatic Pressure Regulator

No. 2973—Designed primarily for manual loading service in conjunction with pneumatic industrial instruments, the new "H-10" regulator is said to combine a high degree of sensitivity with stability and freedom from "drift" errors. Among the many features claimed are: (1) for deadend service the regulator can be adjusted to hold any air pressure from 0 to 25 psi within 0.05 psi regardless of vibration or upstream pressure variation. (2) sensitivity and stability are due to the large area, nylon-inserted





Now supplied with shipping crate that can be used as plenum chamber for economical attic installation.

the all-purpose fan

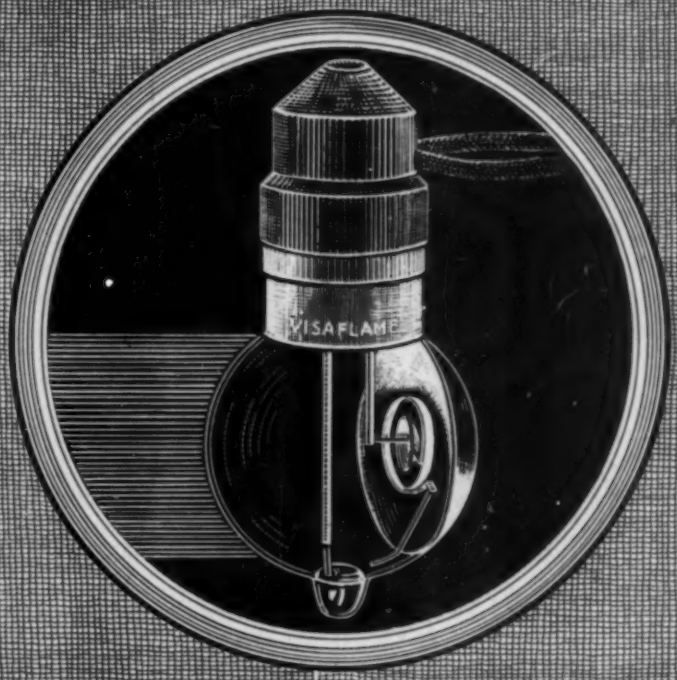
That's the name for the Johnson belt-driven propeller fan shown at left. It's big and its lusty . . . it has an appetite for work and no job is too tough to handle. ★ Displacing air at a rate of 4,500 to 25,000 cubic feet per minute (depending on size) it is capable of giving proper ventilation to small or large residences, offices, restaurants, factories, class rooms, garages, warehouses or any of a hundred different places. ★ The new 1946 model is now ready for delivery . . . sizes range from 24 inches to 54 inches. Order today . . . and save delay.

Johnson Fan & Blower Corp.

1319 West Lake Street *Chicago,* Illinois

MERCOID VISAFLAME

THE LIGHT ACTUATED CONTROL SYSTEM FOR DOMESTIC AND INDUSTRIAL OIL BURNERS



WE SAID: "TRY IT."—They Did.

Read what they have to say now:—

"The dependable service we have had through the use of the Mercoid Visaflame Control through the past five years has decisively convinced our company that it is the safest and most dependable safety control we can secure."

"We are pleased to advise that we have standardized on the use of Mercoid Visaflame Controls—as far as we have been able to ascertain, your Visaflames have given satisfactory operation "

"We have done a considerable amount of field experimental work on industrial, commercial and domestic equipment and after having made the proper type of mounting device to hold the Visaflame Control to meet the requirements and teach the organizations the fine features of it we have had extremely fine results."

"We have no record of any complaints from our customers."

"We expect to continue using the Visaflame Control on all our oil fired heaters."

There are a number of other convincing testimonials.

THE MERCOID CORPORATION, 4201 BELMONT AVE., CHICAGO 41, ILL.

Economical THERMOSTAT SETS

For NATURAL and MANUFACTURED GAS

Finely engineered, field proved packaged sets for compact inventory and convenient installation. Ideally adaptable to gas-fired boilers, floor furnaces, conversion burners and warm air furnaces.

Set includes type K-3B two-wire gas valve, T-70 Metrotherm, transformer and 30 feet of cable.

ADAPTABLE TO L. P. GASES

100% shut-off is assured by the additional installation of an MR-2 electro magnetic thermovalve with 26-R Series pilot burner.

Write for Catalog 52B and Manual FI-101.

GENERAL CONTROLS
801 ALLEN AVENUE GLENDALE 1, CALIF.

FACTORY BRANCHES: PHILADELPHIA • ATLANTA • BOSTON • CHICAGO • DALLAS KANSAS CITY • NEW YORK • DENVER • DETROIT • CLEVELAND • PITTSBURGH HOUSTON • SEATTLE • SAN FRANCISCO • DISTRIBUTORS IN PRINCIPAL CITIES

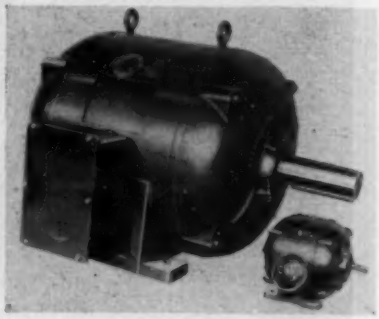
14—2

neoprene diaphragm and to the floating design of plug and seat with its freedom from guiding surfaces which might become a source of friction due to dirt accumulation, (3) because it is close coupled and compact it is suitable for mounting inside an instrument case or on a separately mounted panel, (4) the body and spring housing are of forged brass and the plug and seats are highly polished stainless steel with all other steel parts being cadmium plated, (5) the regulator is provided with a large diameter knurled plastic knob and fine thread screw requiring six or more turns for full range adjustment.

This 3 in. diameter x 4¼-in. regulator is finished in dull black enamel and can be had in either ¼-in. or ⅛-in. standard pipe thread body tappings. It is offered by the Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.

Protected Type Motors

No. 2974—With the addition of three new frame sizes, the Crocker-Wheeler Electric Mfg. Co., Div. Joshua Hendy Iron Works, Ampere 1, N. J., announces that a complete line of squirrel-cage, a-c, protected type motors from 1 to 200 hp is offered. Priced the same as the conventional open type and rated at 40 C rise, full-load continuous duty, with a 15 per cent service factor, these motors are designed to provide protection against dripping liquids, falling metal chips, and other foreign matter.



Sizes built in NEMA standardized frames, 203 to 326 inclusive, have no openings in the frame or shields above the horizontal center line. Standard frames 326 to 505, as well as the three, newly added, larger sizes, are basically the same with the addition of two shielded air exhaust openings in the upper half of the frame. Rotors in which the bars, end rings, and fans are integrally cast in one operation from aluminum alloys are employed for motor frame sizes 203 to 404 inclusive. Rotors for the larger sizes have copper bars with brazed-on fans and end rings. A patented centrifugal bearing seal is used on all ball bearing motors which, the manufacturer claims, permits the use of a softer grease for better lubrication and longer bearing life.

Shown here are the largest and the smallest motors of the line.

Electrostatic Air Cleaner for Railway Coaches

No. 2975—A "Precipitron" unit has been designed by Westinghouse Electric Corp., Cleveland, Ohio, for removing dust and smoke particles from railway coaches. The cleaner, which consumes 75 watts, handles 600 cfm of fresh air and 1800 cfm of recirculated air, is shaped to lie flat overhead just inside the head end door. Before passing through the electrostatic cleaner, the air is first passed through either a cyclone type precleaner or a sieve type filter. The manufacturer states that more than 90 per cent of the total number of dirt particles passing through this unit are removed.

On this completely rebuilt heavy duty shaper at the Krautter-Weber Tool Works, the use of Veelos V-belt provided the following engineering advantages: 1. Eliminated overhead motor and overhead belt drive. 2. Provided better speed control... old drives had only one speed forward and return. 3. Ended noise and excessive vibration.

WHEN the Krautter-Weber Tool Works, Newark, N. J., decided to modernize this heavy duty shaper—built many years ago—it specified Veelos link V-belt on four vital drives. Efficient speed control was a "must"—and, in selecting Veelos, Krautter-Weber chose the belt that helps hold machine speeds at desired rates *by providing uniform belt tension and by eliminating belt slippage:*

1. Veelos Provides Uniform Belt Tension: Veelos patented link construction permits easy adjustment so that each strand of a multiple V-drive carries its exact share of the load. All strands constantly work together, delivering full power.

2. Veelos Ends Slippage: Quick, easy adjustment of Veelos ends belt slippage... keeps machinery running at full speed and assures full productivity.

To modernize old equipment... to assure maximum service on new equipment... to replace V-belts on any equipment... specify Veelos. A Veelos engineer will gladly assist you—just write and arrange an interview.

VEELOS®
THE LINK
V-BELT
Adjustable to any Length
Adaptable to any Drive

MANHEIM MANUFACTURING & BELTING COMPANY
MANHEIM, PA.

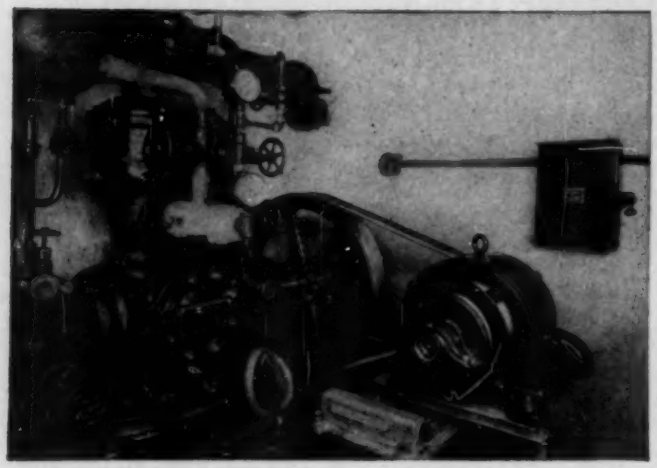
LINK CONSTRUCTION UPS PRODUCTION

IF... your plans for tomorrow include *AIR CONDITIONING*

INVESTIGATE . . .

TANNATE-ROCKWOOD DRIVES

. . . TODAY



Since the heart of an air-conditioning system is the power plant, the success of the system depends upon a reliable, trouble-free drive.

Tannate-Rockwood Short Center Drive efficiency is due (1) to the ***pivoted*** Rockwood base and (2) to the high capacity Tannate flat leather belt. Variation in the load is immediately compensated for by the weight of the motor on the pivoted base, which automatically adjusts the belt tension.

Thus, there is no interruption in the transmission efficiency of the Tannate leather belt, which is designed to grip tightly, run smoothly and pull steadily.

Consult Rhoads Engineering service. Let us tell you about Tannate-Rockwood Drive applied to ***your*** air-conditioning problems.

RHOADS

Tannate-Rockwood

SHORT CENTER DRIVES

J. E. RHOADS & SONS

35 North Sixth Street Philadelphia 6, Pa.

Established 1702 • NEW YORK • CHICAGO • ATLANTA

Fuel Oil Pump

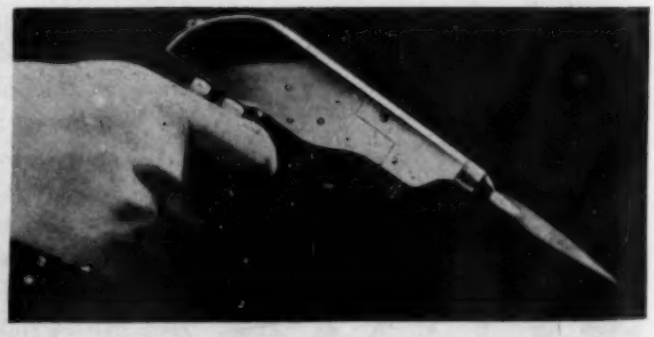
No. 2976—A rotary pumping unit for handling bunker C fuel oil and liquids of similar characteristics has been put into production by the Blackmer Pump Co., 1920A Century Ave., S. W., Grand Rapids 9, Mich. The pump is bronze fitted and operates on the "bucket design" (swinging vane) principle. It is said to be self-adjusting with respect to wear so that there is no loss in capacity during the life of the "buckets" which may be readily replaced when worn. The power unit is a gear-head motor of 50 hp with a speed of 150 rpm at the drive shaft connected to the pump by a flexible coupling. The capacity is 500 gpm at a pressure of 125 psi.

Steel Bar Stock Valves

No. 2977—A series of carbon steel and stainless steel bar stock valves, ranging in size from ⅛ to 1 in., has been announced by the Kitson Co., 1500 Walnut St., Philadelphia 2, Pa. All of these valves are equipped with stainless steel stems and may be obtained with either carbon or stainless steel bodies. They are designed for use in high pressure lines handling air, gas, oil, gasoline, or any other liquid and the stainless steel bodied valves are recommended by the manufacturer for use where the gas or liquid being handled would attack carbon steel but would not affect stainless steel. The valve construction is such that when it is fully opened and under pressure, the stuffing box can be replaced.

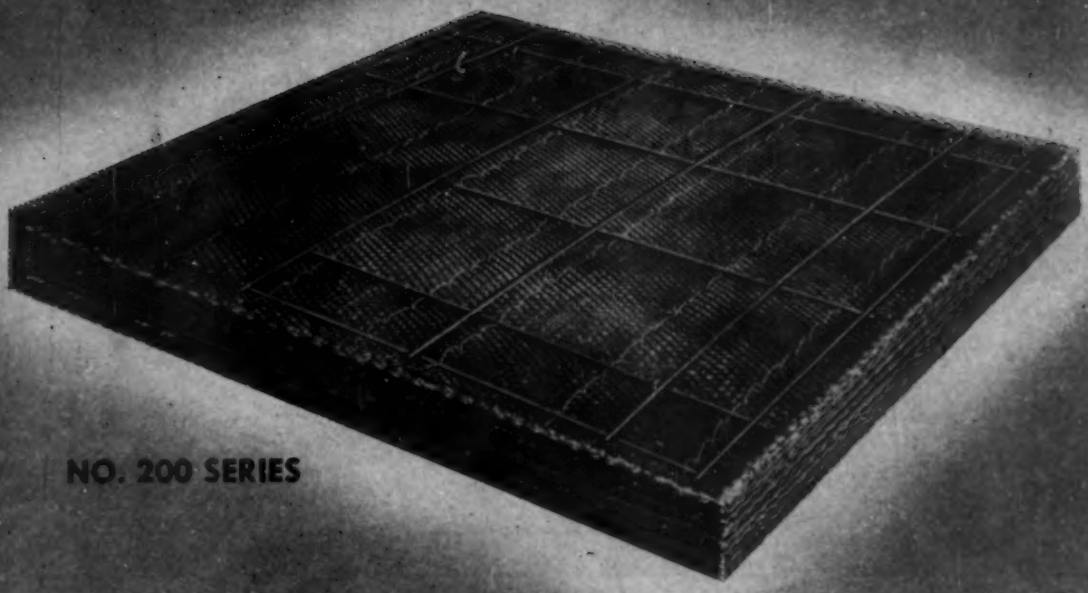
Automatic Gas Gun

No. 2978—A self-lighting, self-extinguishing acetylene torch that ignites with the pull of a trigger and extinguishes on its release is claimed to effect substantial savings in gas consumption for such operations as soldering, silver brazing, light brazing and lead burning, as well as in aluminum soldering, sheet metal work, low temperature welding, tinning, paint removing, and general equipment repair work.



The self-extinguishing feature is said to eliminate fire hazards caused by careless operators who are prone to leave torches burning rather than shut them off and relight when needed. Variations in flame temperature from 950 to 2000 F are obtained by adjusting a pressure regulator. The gas gun is manufactured by the Century Aircraft Co., 5601 W. Century Blvd., Inglewood, Calif.

RESEARCH AIR FILTERS



NO. 200 SERIES

Scientifically Engineered to

FILTER OUT MORE DIRT AND DUST -- CUT AIR FILTER REPLACEMENT COSTS

You'll find Research Air Filters offer you greatest dust removal efficiency in filter banks and industrial dust collection. Catch and hold up to 300% more dust, with lower resistance to air flow. Write for free technical data sheets.

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RESEARCH AIR FILTERS

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That's the reason for the **LOW COST** *and* **ACCURACY** *of the*

ADSCO

ROTARY CONDENSATION METER

Whenever it is possible to collect the condensate from heating or processing lines in a building or department, you can measure your steam consumption accurately with inexpensive ADSCO Rotary Condensation Meters.

These low priced meters detect steam losses and are as positive as a water wheel—so accurate that the slightest trickle of condensate is recorded on direct reading counters.

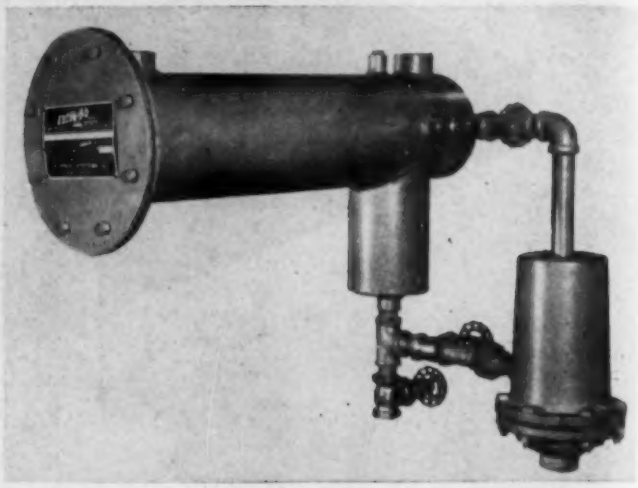
Tell us the maximum pounds of condensate per hour or the square feet of equivalent direct radiation in the building or department to be metered and we will tell you how surprisingly little it will cost to put your steam consumption on a sound accounting basis. Ask for Bulletin 35-80 and No. 35-83H.P.

ADSCO FLOW METER
For measuring the flow of steam, water, air or gas, no other meter is so simple or rugged. Recommended where a 24 hour visual chart record of flow, an indication of the pressure and a totalization of the flow through the line is desired.

AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA, NEW YORK
Makers of "UP-TO-DATE" Steam Line Equipment For Over 65 Years

Water Separator

No. 2979—The new "E-25 Excel-So" water separator and filter is designed to remove dirt, water, and muck from fuel oils at storage tanks, fuel trucks, diesel engines, barges, water terminals, and many other places where diesel oils or gasoline are handled or stored. Being a little over 2 ft long, it can be mounted on trucks or in crowded compartments, and its capacity is 25 gpm. With the water valve and interconnections shown servicing is possible with no shutdown of the system. Other, more compact, units are available with the dump valve located inside the accumulator leg.



The manufacturer states that due to combined coalescing, settling, and filtering, water in amounts up to 6 per cent of the rated capacity can be removed continuously and automatically and that gasoline 99.999 per cent water-free has been obtained in government tests.

The evenly bedded, deep, coalescing media also traps solids. With clean fuels, the media will last indefinitely no matter what the water content, and when handling dirty fuels, the media can be replaced quickly with an inexpensive repack whenever required, says the manufacturer.

For refineries, pipe lines, or other large installations, units are available in sizes up to 1500 gpm capacity with practically any valve arrangement or safety features, and with API-ASME construction. These water separators are offered by the Flotrol Systems, Inc., 385 Gerard Ave., New York 51, N. Y.

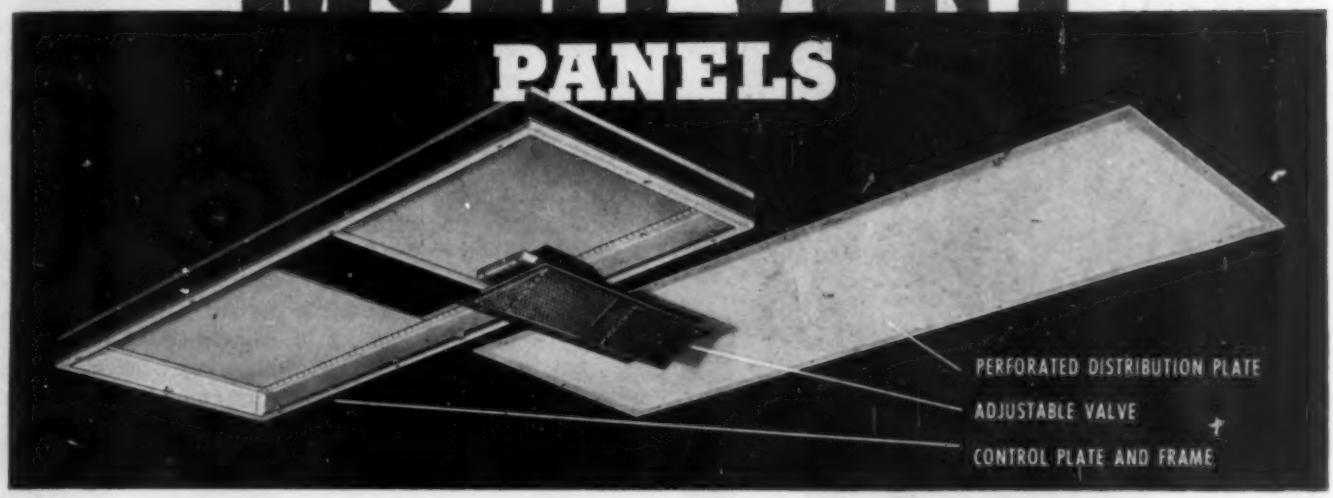
Improved Gasketing

No. 2980—An improved type of gasketing is announced by the Products Research Co., 634 S. Western Ave., Dept. A41, Los Angeles 5, Calif., called "Chrome Lock." This material has been used extensively in the ventilation and forced draft blower systems of battleships, destroyers and other vessels.

Among the many advantages claimed by the manufacturers for this product are flame resistance, fuel resistance, rust-inhibition, anti-wicking, non-oxidation, non-hygroscopic, compressibility, longer life, cushioning, ease of handling and lower costs. It is, say the manufacturers, the only gasketing that offers adhesion to metals without cementing the gasket to the flange, assuring a positive seal.

PYLE-NATIONAL

MULTI-VENT PANELS



for heating, ventilating and air conditioning

Uniform, draftless air distribution provided by Multi-Vent panels assures superb comfort. Conditioned air enters the occupied spaces through the large area perforated ceiling plate of the Multi-Vent panel, delivering air at low velocity, accomplishing complete dilution with room air, and producing a very gentle flow of air around all occupants.

Design. Multi-Vent panels are ceiling panels consisting of (1) the control plate frame, which is mounted in the duct at the ceiling; (2) the orificed adjustable air valve, which may be set for the quantity and velocity of air delivery needed; and (3) the perforated distribution plate of large area, providing widespread, gentle, uniform delivery of conditioned air.

Simple Installation. Multi-Vent panels are mounted in the duct, flush with the ceiling, or in exposed duct work, flush with the bottom of the duct. The Multi-Vent panel goes into place as a unit, is easily handled, and is provided with felt seals around the panel frame to prevent air leakage from the duct.

Easy Adjustment. The air valve in each Multi-Vent panel is adjustable, allowing the quantity of air and the velocity of delivery to be varied to produce the comfort zone rate of air motion and degree of temperature desired by occupants. Adjustment is simple, and when the desired balance is obtained, adjustments are locked in place.

Easy Servicing. Both perforated distribution plate and upper control plate are hinged for easy access for cleaning. The downward flow of air from Multi-Vent panels prevents dirty ceilings. The perforated distribution plate can be removed for washing or painting.

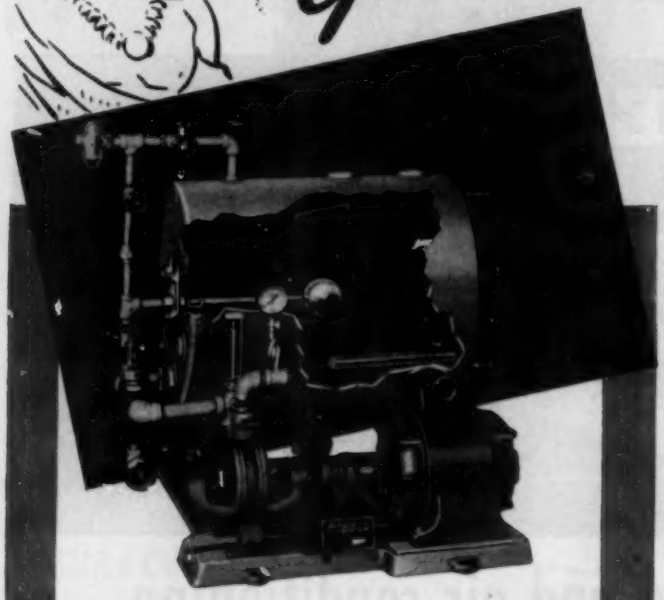
Superb Comfort. Multi-Vent panels provide uniform, draftless air distribution at low velocity, with adjustment available to suit individual preferences, resulting in maximum comfort for occupants in all seasons.

Bulletins describing Multi-Vent applications and performance will be sent upon request.

THE PYLE-NATIONAL COMPANY
1334-58 NORTH KOSTNER AVE. • CHICAGO 51, ILL.

MAKE YOUR BOILER AN

"Indian Giver"



SCHAUB Standard Boiler Return SYSTEM

● When your *boiler* can get back hot condensate (up to 210°), *you* are receiving maximum efficiency and economy from your heating plant. And you add to that advantage when you can maintain a constant water level for uniform steam pressure and steam space in the boiler.

The Schaub Boiler Return System makes this possible. This system provides for:

1. Uniform boiler water level automatically maintained.
2. Return of all high and low pressure condensation as hot as 210° without vapor binding.
3. Addition of necessary make-up water automatically.
4. High and low water fuel cut-off protection, and high and low water alarm.

All these features mean fuel savings and increased efficiency for your equipment. Don't be without the advantages of the Schaub Standard Boiler Return System.

FRED H. SCHAUB ENGINEERING CO., INC.

680 N. Orleans Street, Chicago 10, Illinois

The Key to Boiler Room Efficiency

SCHAUB SYSTEMS

Cast Iron Cooler Element

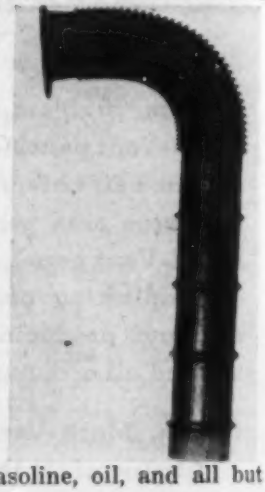
No. 2981—Using experience gained during the war in producing units that cooled highly concentrated sulphuric acid from 475 F to 175 F or lower in making high explosives, the National Radiator Co., 221 Central Ave., Johnstown, Pa., has developed its new U-cast hairpin cooler element for peacetime applications. The unit is used for cooling any liquid, but is said to be especially adapted for cooling acids or strong alkalies under extreme conditions.

The elements in these applications are submerged in the solution and the coolant, usually water, is passed through the element itself. The sections of the unit are cast of gray iron that is claimed to be resistant to attack from both the solution and its fumes.

The manufacturer states that the coils formerly used in the acid cooling vats of munitions manufacturers had to be completely replaced at least every three months, whereas after months of service in the same vats, the new cast iron elements showed no corrosion either above or beneath the liquid line. In some cases a small amount of sulphate deposit formed above the liquid line, but a coating of acid-resistant paint eliminated this. The cooling capacity and efficiency of the new elements were as satisfactory as or better than the coils formerly used, the plants reported.

Rubberized Glass Cloth Duct Material

No. 2982—A new material, "Airtron," created during the war and used extensively in aircraft heating and ventilating is now offered for use by other manufacturers as a ducting for hot or cold air. It is made of glass cloth impregnated with synthetic rubber and is said to provide high insulation qualities as well as great flexibility. Other features claimed are: (1) the flexibility makes it adaptable where vibration is present; (2) it will withstand temperatures from –60 F to 300 F without change in properties and will stand over 50 psi internal pressure at all temperatures; (3) it is unaffected by air, light, water, gasoline, oil, and all but concentrated mineral acids.



The material is fabricated in tubes from 1 to 6 in. in diameter and in any length desired, as well as in specialized shapes where required for unusual installations. The manufacturer, Arrowhead Rubber Co., Dept. B-52, 2244 E. 37th St., Los Angeles 11, Calif., considers that many applications for this product will be found in heating, ventilating, and air conditioning in the transportation field, in stationary installations, and for specialized commercial and industrial processes.

Special Pipe Fittings for Low Pressure Drop

No. 2983—"WeldOlet" fittings played an important part, says the manufacturer—Bonney Forge & Tool Wks., 350 Green St., Allentown, Pa.—in solving a pressure loss problem on the continuous gas furnaces manufactured by the Selas Corp. of America, one of which

The Lombard Governor Corporation of Ashland, Mass., are manufacturers of governors, valves, pumps and other industrial equipment.

This No. 60 Smith oil-fired boiler not only heats Lombard Governor's new plant but furnishes process steam as well. Header type cast-iron construction minimizes breakdown possibilities while assuring lowest maintenance costs.

With most modern small and medium sized factories buying power, it becomes increasingly desirable to install a boiler plant which will operate with maximum flexibility, yet require a minimum of attention. The hundreds of H. B. SMITH cast-iron boilers installed in factories during the war years provide the answer to this problem.

Operating efficiently with oil, coal or gas, H. B. SMITH boilers not only handle heating loads but in many cases take care of process steam, air conditioning units and domestic hot water as well.

Architects, engineers and contractors who will be judged by the operation of the equipment they recommend will do well to profit by these war-time experiences and specify a known quantity in boiler performance . . . H. B. SMITH.

H.B. Smith
CAST-IRON BOILERS

THE H. B. SMITH COMPANY, INC., WESTFIELD, MASS.
Branch Offices and Sales Representatives in Principal Cities

INSULATE EVERY DUCT

Saves 75% of Bare Duct Heat Loss.

•

Thermal Insulating Efficiency of 70%.

•

K Factor .27 B.t.u.

•

Frictional Resistance F — 0.0001322.

•

Deadens Metallic Noises.

•

Absorbs 70% of Air Borne Noises.

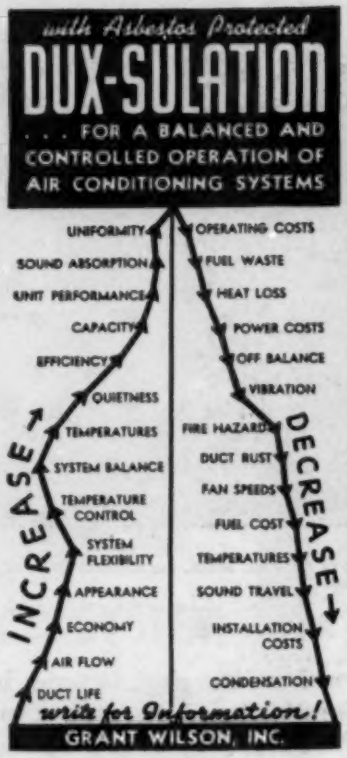
•

Prevents Condensation.

•

Complete for Easy Installation.

DUX-SULATION is the Asbestos Protected Insulation Felt that excels in every operation from cutting to finishing and insulates against heat, cold and sound. It is a proven product designed and developed especially to be the most satisfactory and efficient insulation for Ducts.



DUX-SULATION is approximately ½" thick and is composed of millions of fine flexible fibres fabricated into a Felt of unusual strength. The fineness of the fibres and the manner in which they are built up gives you the many dead air spaces so necessary for high thermal insulation and sound absorption.

A heavy Asbestos membrane is woven into the Felt body just below the soft surface which gives you the protection of fire-proof Asbestos. The outer or top surface is a heavy woven fabric through which the fine fibres are worked so that the very top surface is finished into an attractive sound absorber.

DUX-SULATION can be applied to round pipes, rectangular ducts or irregular surfaces. It bends in any direction, even to very sharp and abrupt angles. It sweeps over the duct work as though it were a part of the sheet metal itself. When the tape is neatly applied to the corners and the joints, you have a very attractive completed job that harmonizes with almost any surrounding.

GRANT WILSON, INC.

141 WEST JACKSON BLVD. AT LA SALLE ST. . . . CHICAGO 4, ILL.
(22nd Floor, Board of Trade Bldg. Phone: Wabash 8220)

Send Bulletin No. 407-P containing the full story of DUX-SULATION—the all purpose insulation.

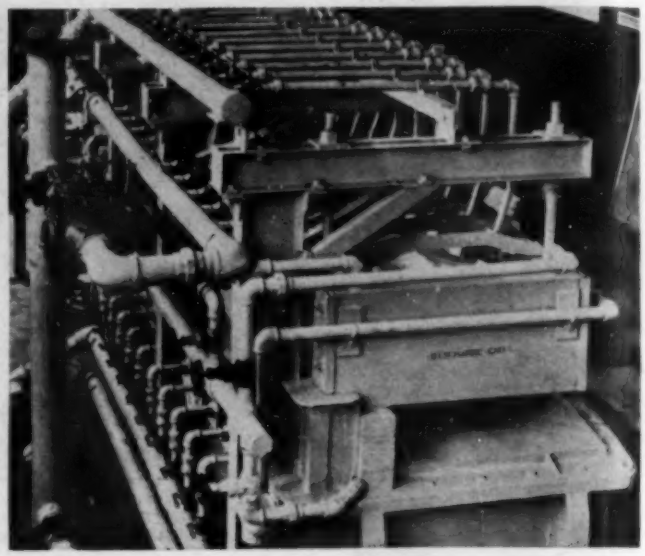
FIRM NAME .....

STREET .....

CITY..... STATE.....

ATTENTION OF .....

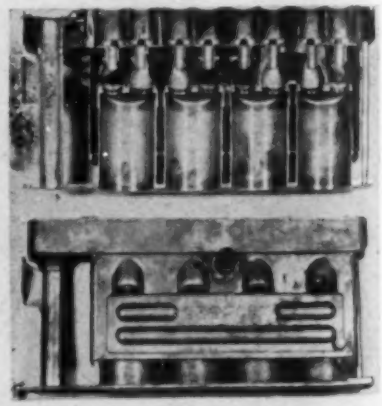
is shown here. The precise operation of this process heating equipment demands full burner operation and efficiency. However, too great a gas pressure drop was experienced between the burner manifold and the burners, and tests indicated that the major loss occurred between the manifold and the outlet end of the valve. A different type of valve was installed but the loss was still too great so that these fittings (incorporating funnel shaped inlets) were used in place of nipples welded to the burner manifold.



The manufacturer says that the problem was eliminated through the use of these fittings which eliminate "dead" spots and provide full flow capacity.

Small Gasoline Engine of Welded Construction

No. 2984—A new automobile engine hardly bigger or heavier than a standard typewriter and weighing only 59 lb but developing 26 hp has been announced by Crosley Motors, Inc., 3289 Spring Grove Ave., Cincinnati 25, O. While it will be used to power a small automobile, it is available for many uses including refrigeration and air conditioning equipment, motor generators, pumps, and small auxiliary power plants.



The cylinder block is made up of light walled alloy steel tubing for the cylinders and cam follower guides, and of sheet steel stampings for the cylinder heads, intake and exhaust ports, valve cases, and water jackets. The parts are held in place by shrink fits, spot weld or crimping operations. The assembly is then copper brazed in a special furnace at 2060 F. Low cost, light weight, and high efficiency are among the advantages claimed for this unit which was developed during the war for the Navy.

LEEDS & NORTHRUP COMPANY

Measuring Instruments - Telemeters - Automatic Controls - Heat-Treating Furnaces

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TULSA 3: 4th and Main Sts.....Phone Tulsa 4-3720

INSTRUMENTS FOR THE BUILDING ENGINEER

No method for measuring temperatures fits the specific needs of air conditioning as does the three-lead, null-type resistance thermometer method.

The L&N equipments which employ this method consist of Micromax Recorders or Indicators, with Thermohm electrical-resistance thermometer bulbs as temperature detectors.

THERMOHMS ARE SENSITIVE

Thermohms can be placed anywhere—in rooms, air ducts or water lines . . . and are outstandingly sensitive and durable in any service. They are connected by a simple electrical wiring to the instruments, which are at a central location. Distance between instrument and Thermohm may be as large or small as desired. Instruments may be: Micromax Recorders, Strip-Chart for up to sixteen Thermohms, or Round Chart for related temperatures such as inside and outside, wet and dry bulb, or temperature of incoming and outgoing air or refrigerant. Indicators may be included, with switches for any number of Thermohms which may or may not normally be connected to a Micromax Recorder.

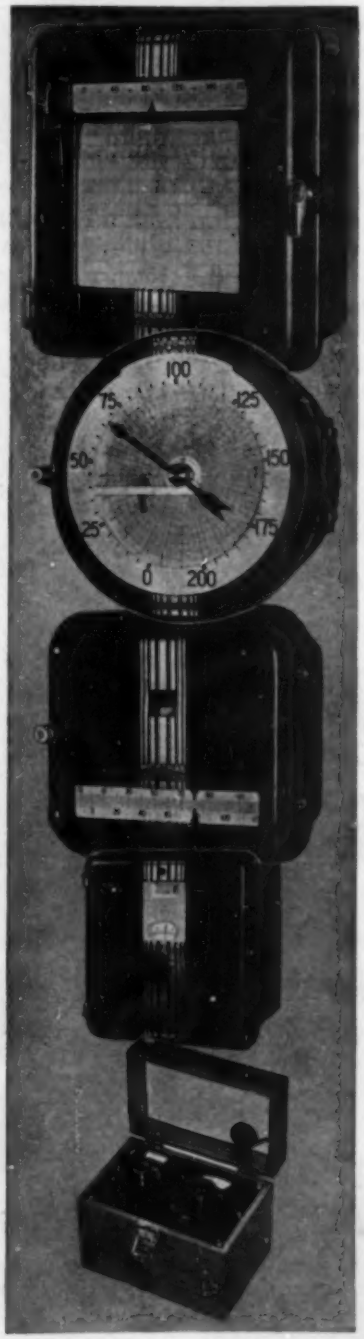
RELIABILITY AND ACCURACY

Reliability of operation is the principal characteristic of this equipment. It is strongly made; put together snugly and rigidly; built like a machine-tool. The complete system is easy and economical to install and operate. Thermohms are interchangeable and if ever damaged can be replaced without disturbing wiring or returning anything to the factory.

L&N Resistance Thermometers make it possible to operate efficiently; to maintain comfort or correct process atmosphere constantly . . . so that maximum return is realized on the conditioning investment.

These equipments are described in our 48-page Catalog N-33C, which will be sent on request. If you have a specific problem, outline it and we will send specific recommendations.

Jri Ad N-225(4)



This L&N family of instruments comprises (top to bottom): Strip-Chart Micromax Recorder, Round Chart Micromax Recorder, Non-Recording Micromax Controller, L&N Panel Indicator and L&N Portable Indicator.

INSTRUMENTS AND CONTROLLERS FOR THE POWER ENGINEER

For heating plants and similar installations we supply L&N Type P Combustion Control to regulate the firing with dependability, sensitivity and economy. Entirely electrical, it can be installed by any competent electrician and used by any fireman. See Catalog N-01P-163.

All that you want a CO_2 Recorder to be, you will find in the Micromax CO_2 Recorder—it's dependable, sensitive, accurate, and as easy to care for as a temperature recorder. You or your fireman can save fuel by having this Recorder where it can be read at a glance, every day and all day. See Catalog N-91-163.

If you have a Smoke Ordinance a Micromax Smoke Density Recorder can show you the truth about stack-smoke, and record it for your information and protection.

MICROMAX FOR TEMPERATURE RECORDS

Temperatures of steam, air, oil, water and flue gas are recorded with economy, accuracy and dependability by Micromax Recorders, either Strip-Chart or Round Chart, shown at left. Strip-Chart can handle as many as 16 thermocouples or Thermohm resistance-thermometer bulbs; and can record in as many as 6 colors; it records with outstanding clearness because of its wide chart and highly micro-responsive mechanism. Round-Chart Micromax concentrates on one or two thermocouples or Thermohms, but can be read from across a large room.

Simplicity of operation, with the high accuracy required of a test instrument, are the features of L&N Portable Indicators; ask for catalogs.

INSTRUMENTS FOR TESTING, RESEARCH AND TEACHING

We manufacture Electrical Measuring Instruments of dependability, precision and sturdy construction, for practically any laboratory need. Included are:

Wheatstone Bridges Potentiometers
Photometers Kelvin Bridges Standards
Galvanometers A-C Bridges Test Sets
Dynamometers

Ask for Broadside E.

Fly Ash Removal System

No. 2985—Until recently the electrostatic precipitator known as the "Precipitron" has confined dust collecting activities mostly to offices, home, and factory process or assembly rooms. Last year Westinghouse Electric Corp., Cleveland, O., combined it with a Prat-Daniel cyclone type mechanical dust collector to do the heavier job of trapping the fly ash from the stack of a large power station

All of the gas and dust enter the mechanical collector. This collector is made up of vortex tubes that spin the gas at high velocity. The centrifugal force, says the manufacturer, removes the large particles. The gas leaving the vortex tube is still spinning at a great speed so that the remaining dust is concentrated near the inside wall of the tube. By skimming off the part of this gas-dust mixture nearest the wall, only 6 per cent of the dust is expelled directly up the stack. The skimmed portion of gas and dust is conducted into the precipitator which is said to remove 90 per cent of the dust passing through it. The remaining dust, constituting 1 per cent of the original, and the gas are discharged into the stack. According to the manufacturer, the dust emanating from the stack then is 7 per cent of the total so that the overall efficiency of removal is 93 per cent.

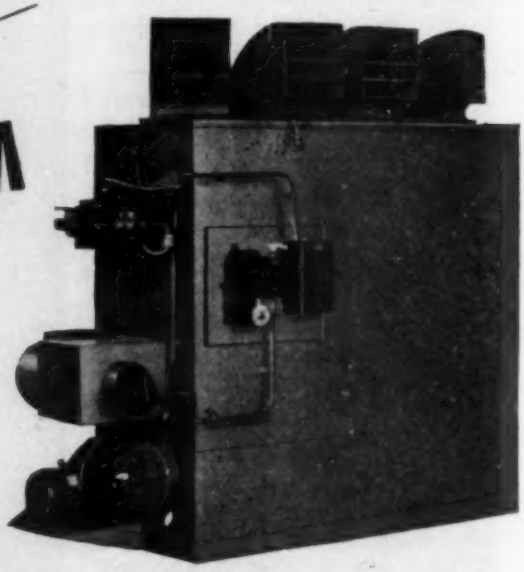
Small Electric Motors

No. 2986—A new line of small electric motors has been announced by Eastern Air Devices, Inc., 130 Flatbush Ave., Brooklyn, N. Y. These motors, which are said to incorporate improvements in noise reduction and bearing lubrication, are designed for various uses among which are small fan and blower applications. The 115 volt, 60 cycle, single phase motors offered are of the capacitor, shaded pole, and synchronous types and are available from 1/300 to 1/10 hp.

New Service for Heating Industry

No. 2987—The Marsh Tritrol Co. has broadened its activities and will now distribute the heating specialties distributed by Jas. P. Marsh Corp. along with the "Tritrol" regulator. In keeping with the broadened operations, the firm name is being changed to Marsh Heating Equipment Co., with main offices at 2120 Southport Ave., Chicago 14, Ill. James Emmett, Jr., will head the staff as vice-president in charge of sales.

Aimed at rehabilitating old heating systems and providing modern, efficient systems in new buildings, the company will offer service developed to cover both the distribution phase and the control phase of heating systems. In the distribution phase there is available a complete line of steam traps—radiator traps, float traps, thermostatic traps, combined float and thermostatic traps, inverted bucket traps—also venting devices, radiator air valves, and packless radiator inlet valves. In the control phase, the regulator, which is designed to keep heating in step with outside temperatures and to program heating in accordance with hours of activity in the building, will spearhead the new service.



THE new Airtherm Space Heater provides an even distribution of heat to all parts of the building through high velocity nozzles — is installed with a minimum of installation costs and requires practically no maintenance.

The new Airtherm Space Heater is available in 3 models — for floor mounting (as illustrated) or horizontal or vertical suspension. Choice of gas or oil burners on all models. Capacities from 650,000 to 1,950,000 BTU's per hour.

Write for bulletin describing this new, efficient, money-saving heater, in detail.

AIRTHERM
MANUFACTURING COMPANY
711 S. Spring Avenue • St. Louis 10, Missouri

Alnor

VELOMETER

The Alnor Velometer

...the only instantaneous direct reading Air Velocity Meter

The only quick, convenient direct-reading means of checking air motion in ventilating, drying, air conditioning, and similar installations is with the Alnor Velometer. This instrument gives reliable information so easily that engineers and service men are encouraged to take complete data, for correct and efficient operation.

With the Alnor Velometer instantaneous direct readings of air speed are measured in feet per minute. With it checking draft, leaks around doors and windows, or in ducts, measuring velocities at outlets or in ducts is simple and convenient. Anyone can use the Velometer—without calculations, leveling, timing, or other time-consuming conversions.

The Velometer is made in several standard ranges from 20 fpm to 6000 fpm, and up to 5 inches static or total pressure. Special ranges available as low as 10 fpm and up to 25,000 fpm velocity and 20 inches pressure. Extension jets permit accurate readings in many locations that would be completely inaccessible with other means of measurement. Write for Velometer Bulletin.

Velometer used for negative static pressure readings

Checking return grille reading with Velometer and suction type jet

ILLINOIS TESTING LABORATORIES, INC.
420 NORTH LA SALLE STREET
CHICAGO 10, ILLINOIS

New TENNEY Thermostatic Expansion VALVE offers these features

HALF ACTUAL SIZE

Model TS-1 TENNEY Thermostatic Expansion Valve, for Standard Commercial use, such as Air Conditioning, Display Cases, Refrigerators, etc. Sectional view, showing new construction and design features.

- **Has no Feeler Bulb**
- **Not affected by box temperature, entering warm air, or warm suction lines**
- **Responds instantly to changes in suction vapor conditions**
- **Maintains close super heat control**
- **External equalizer unnecessary**
  —compensation for pressure drop in evaporator designed into valve
- **No sticking or binding**
  —no stem packing required
- **Exact sizing of valve to job unnecessary**
  —no appreciable time lag in control
- **No over-feeding or under-feeding ("valve swing")**
- **No special installation required**
  —to prevent loss of control by condensing of bulb control fluid in valve body
- **Closes completely above definite evaporative pressure**
- **Eliminates all special "charging" and "cross-charging"**
  —for operation in specific temperature range

These and other features of this New TENNEY Thermostatic Expansion Valve stamp it as the first forward improvement in expansion valve design in 20 years. New Valve has been so engineered as to overcome previously encountered expansion valve disadvantages.

Particularly adaptable to modern evaporators with forced air, small tubes, short passes and distributor header combinations. Also ideal for small evaporators or modern close coupled coil and machine combinations.

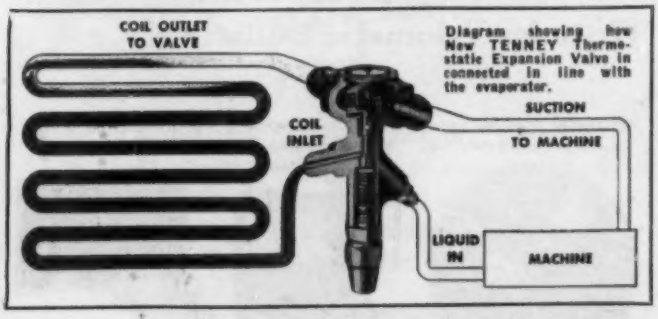


Diagram showing how New TENNEY Thermostatic Expansion Valve is connected in line with the evaporator.

Distributors and representatives now being established in principal cities. A few desirable territories still open. Send for special bulletin, prices and discounts.

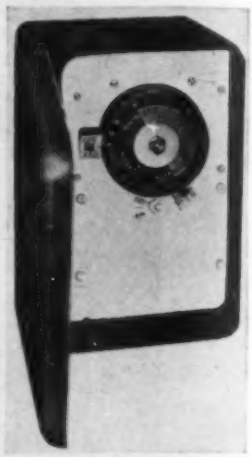
TENNEY ENGINEERING, INC.
26 AVENUE B • NEWARK 5, N. J.
Manufacturers of Automatic Temperature, Humidity and Pressure Control Equipment

Open Blade Snap Switch

No. 2988—A new type smaller size open blade snap switch, identified as "Model M", has been developed to fill the need for a compact, sturdy, popular priced switch for vertical mounting. Designed for compactness, for mounting in multiples as well as singly, the operating blade, center blade and patented rolling springs are made of a heat treated beryllium copper. Overall dimensions are approximately 1 13/32 × 1 1/64 × 5/16 in. Standard operating pressure is 6 to 10 oz. It is furnished for single pole, normally open, normally closed, and double throw circuits. Acro Electric Co., 1392 Superior Ave., Cleveland 14, O., is the manufacturer.

Time Switch

No. 2989—A new "Series TS3" time switch, which was developed during the war is now coming off the production lines. Except for motor and gearing it has only two moving parts. As a consequence this time switch is said to provide regular, dependable operation and exceptional freedom from repair and attention.



The unit is powered by a "Telechron" motor and gear train. Heavy duty, totally enclosed switches are used in heavy duty models. The light duty models are equipped with enclosed dustproof snap switches. There are 6 standard models available and 35 amp, extra heavy duty models may be obtained on special order.

The switch is designed for many uses including starting and stopping stokers or oil burners. It also may be used for controlling electric signs, commercial lighting, fans, blowers, pumps, motors, valves, gas burners, etc. It is manufactured by the Miller Heat-O-Meter Co., 1434 W. Atkinson Ave., Milwaukee 6, Wis.

Metal Surface Preparation

No. 2990—The Amercoat Div. of American Pipe and Const. Co., P.O. Box 3428, Terminal Annex, Los Angeles 54, Calif., announces two new products supplementary to their line of plastic coatings.

"Amercoat No. 59"—surface preparation for zinc, is a treatment for galvanized metal surfaces prior to application of a protective coating.

"Amercoat No. 60"—surface preparation for copper and brass, is a similar treatment for these metals.

These surface treatment solutions are for use where shot or sandblasting are impractical. The resulting adhesion of the protective coating is said to be excellent where applied over a zinc, copper or brass surface properly prepared by these methods.

IMPROVE YOUR KNOWLEDGE OF AIR CONDITIONING

$2.00

SEND TODAY FOR

Samuel R. Lewis'

"AIR CONDITIONING FOR COMFORT"

288 Pages—6¼" x 9¼"—Illustrated—
Cloth Bound—$2.00

Here is a book that presents—in simple, readily understandable form—every kind of information necessary for an accurate and thorough knowledge of air conditioning principles, equipment, and practices. Written by S. R. Lewis, a widely-known consulting engineer who has been active in air conditioning work for more than thirty years, it deals with all angles of the air conditioning subject from the practicing engineer's viewpoint. The designing procedures explained in the book are, for example, in every detail the same procedures employed today by the author's own organization.

Featuring this third edition are chapters on phases of the subject not previously treated, including noise control, air conditioning measurements, air conditioning standards, fire protection codes and operating suggestions. Several complete examples of correct design procedure are given, together with forms for recording the design data, the proper filling-in of which are explained step-by-step.

The chapter devoted to Psychrometry presents nineteen different formulas for psychrometric calculations. In illustrating the correct use of these formulas, Mr. Lewis applies both the psychrometric tables and chart in order to render both devices thoroughly understandable.

OF VALUE BOTH AS A REFERENCE AND TEXT

Engineers in air conditioning will find the "Air Conditioning for Comfort" invaluable as a reference book, while salesmen, students, and others may rely on it to give them a clear knowledge of fundamentals, and of air conditioning methods and equipment.

Send for a copy today. We know you will consider this volume one of the most readable and complete books on the air conditioning science you have yet seen. You will risk nothing in ordering a copy, for you will be privileged to return it for a refund if for any reason it should prove unsatisfactory. Use the coupon at the left to order your copy now.

KEENEY PUBLISHING COMPANY
6 N. Michigan Ave. Chicago 2, Ill.

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CHAP. 1—Terms used in Air Conditioning
CHAP. 2—Heat and Air
CHAP. 3—Air Conditioning Standards
CHAP. 4—Air Conditioning and the Human Body
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CHAP. 6—Humidity Controllers and Control
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CHAP. 19—Air Conditioning Instruments and Measurements
CHAP. 20—Codes and Operating Suggestions
10" x 10" Psychrometric Chart..Inside Back Cover

KEENEY PUBLISHING COMPANY
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Enclosed is $2.00 for a copy of AIR CONDITIONING FOR COMFORT. If this book should prove unsatisfactory, I will return it within 15 days for a refund.

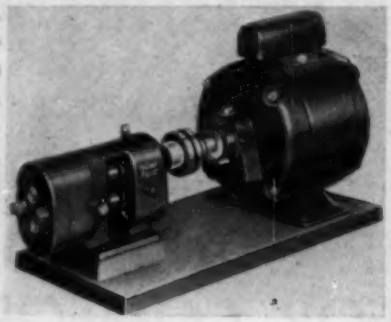
NAME .....

STREET .....

CITY & STATE .....

High Pressure Pump

No. 2991—A new, low capacity, high pressure pump, suitable for thin liquids or water up to 500 psi and viscous liquids and oils up to 1000 psi, has been announced by the Bump Pump Co., La Crosse, Wis. Designed to operate on vacuums up to 27 in., the flow is said to be constant regardless of pressure. It is also designed so that impellers may be changed to handle any capacity from 60 to 480 gph and is furnished with standard foot mounting as illustrated.



Among the optional features offered are: (1) side intake and discharge or intake and discharge on the face plate, (2) mechanical seals or the conventional type packing, (3) bronze sleeve or ball bearings, (4) bypass with pressure relief valves, (5) construction in a variety of materials such as cast iron, bronze, and stainless steel.

Pipe Corrosion in Buildings

No. 2992—A corrosion research exhibit which is used to demonstrate the effects of water on the pipes in buildings together with modern methods of combatting corrosion troubles is now open at the Water Service Laboratories, 423 W. 126th St., New York City.

Many samples of corroded pipes, taken after examination of more than 8000 multi-story buildings, demonstrate the effects of corrosion in iron and brass pipes. A fact, says this company, which is often overlooked is that the durability of various pipe materials is also dependent upon the composition and characteristics of the water handled.

Silicone Greases

No. 2993—Two new silicone greases which are said to be serviceable in ball bearings operating at speeds up to 10,000 rpm and which are subject to bleeding of less than 2 per cent after 16 hours of operating at 230 F have been announced by the Dow Corning Corp., P. O. Box 592, Midland, Michigan. One of them, "DC33," is said to be effective over a temperature range of —94 to 300 F while the other, "DC44," is serviceable at temperature ranges from —4 to 345 F.

Plastic Seals

No. 2994—A new type of plastic compound said to offer many possible uses, particularly in making seals that are air tight and water tight, has been developed by the General Electric Co., Plastics Div., 1 Plastics Ave., Pittsfield, Mass. This material was developed to seal the ends of metal tubing to keep the interior free of dust and moisture while being shipped, stored, or handled. New uses are being discovered daily, the most recent ones being lead markers on wires and cables. Completely water resistant, they are being used on air conditioning and refrigeration equipment. They can be produced to specified diameters and thickness.

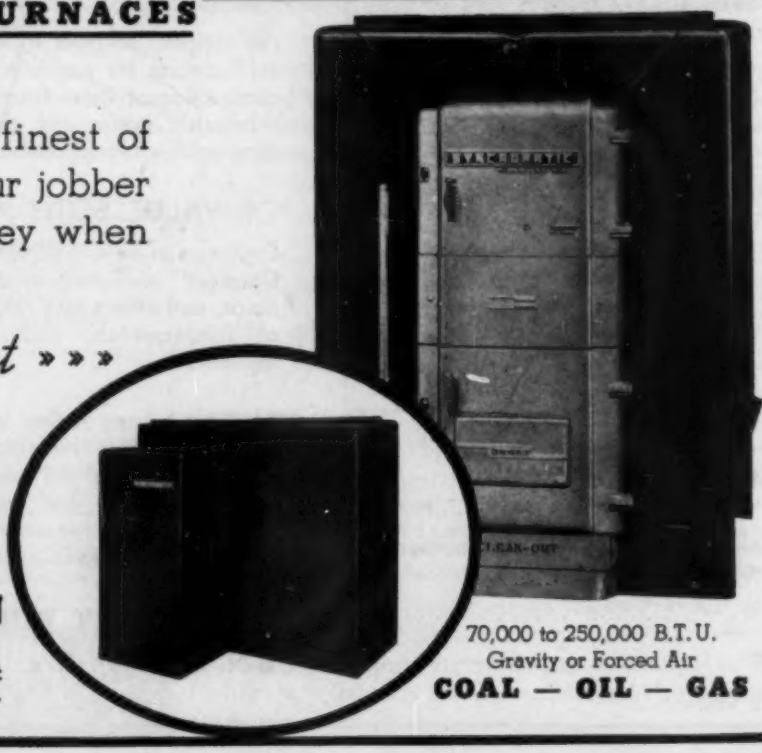
SYNCROMATIC

MODERN STEEL FURNACES

YOU'VE seen these finest of steel furnaces at your jobber —you've made money when you installed them!

We're glad that »»»

more and more of you are becoming "SMART BOYS"



70,000 to 250,000 B.T.U.
Gravity or Forced Air
COAL — OIL — GAS

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Factories: Milwaukee and Watertown, Wis.

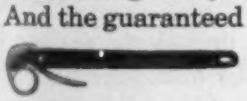
Offices: 5110 N. 35th Street Milwaukee, Wis.

You do it faster, more easily, with this guaranteed RIDGID HEAVY-DUTY PIPE WRENCH

TRADE RIDGID MARK
RIDGID
UNCONDITIONAL GUARANTEE
If this Housing ever Breaks or Distorts we will replace it Free
THE RIDGE TOOL CO.
ELYRIA, O.

This means no more wrench housing repair expense!

● Pick up a RIDGID by the powerful comfort-grip I-beam handle and it *feels* like an unusually efficient wrench. It *is*. The precision-cut alloy jaws grip pipe firmly, let go instantly. Adjusting nut spins easily in all sizes, won't bind. You like the handy pipe scale on the full-floating hookjaw, the replaceable heeljaw. And the guaranteed housing assures you long expense-free service — most for your money. Ask your Supply House.



RIDGID *Strap Wrench.*

RIDGID

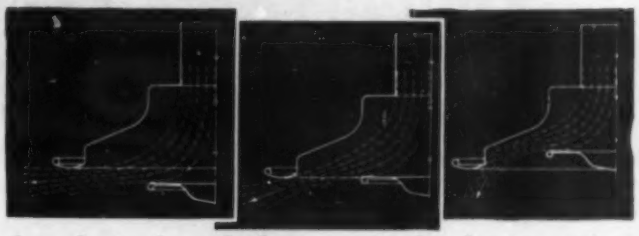
WORK-SAVER PIPE TOOLS

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

How *adjustable* air diffusers increase the efficiency of supply air diffusion.

Better mixing of room and supply air, more uniform temperatures throughout the occupied zone and noiseless, draftless air diffusion are accomplished with

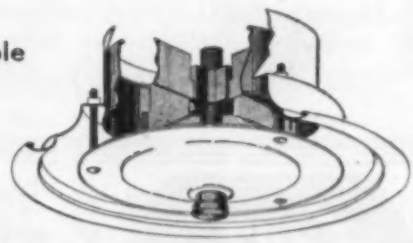
KNO-DRAFT *adjustable* Diffusers



Any desired angle from vertical to horizontal at your fingertip.

By simply turning the air adjustment screws (easily accessible from under the unit) the inner cone of any KNO-DRAFT Diffuser may be raised or lowered to secure any angle of air direction required by ceiling heights, system balancing, and individual or seasonal requirements. Thus the diffuser becomes more effective whether it is used in cooling, heating, ventilating, or combined systems, because it can expel chilled air parallel to the ceiling or eject heated air downward to prevent stratification.

Type K Adjustable Diffuser with Type D Volume Damper.



Pat. and pat. pending

Any desired volume at your fingertip

Every KNO-DRAFT Diffuser can be equipped with a built-in volume damper (easily adjusted by hand-turning knob under diffuser) which varies the outlet aperture uniformly without affecting the outlet velocity or diffusion pattern.

Thus KNO-DRAFT Diffusers can be adjusted quickly and accurately to the angle and volume needed to meet a wide variety of conditions, and as a result, the factors of temperature variation, temperature fluctuation, drafts and noise can be minimized considerably.

The W. B. Connor Engineering Corp. maintains a staff of specialists and district representatives in leading cities to assist you with any air distribution problem.

FREE HANDBOOK

Contains clear sketches, charts, dimension prints and instructive text that simplify the selection and installation of air diffusers.

For your copy write Dept. **D-11.**

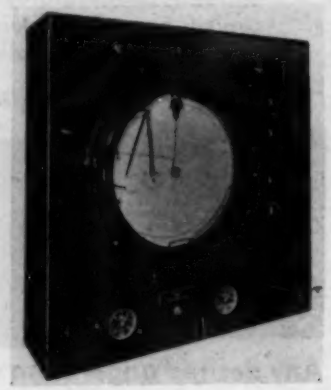
W. B. CONNOR ENGINEERING CORP.

Air Diffusion *Air Purification* *Air Recovery*

114 E. 32nd Street — WB CONNOR — New York 16, N. Y.

Cycling Controller for Rate of Temperature Rise

No. 2995—For batch type processes and other operations where rate of temperature increase or decrease must be controlled as well as the actual processing temperature and duration, The Foxboro Co., 106 Neponset Ave., Foxboro, Mass., has developed the "CycleLog" controller, now available as a standard item in the company's line of instruments for measurement and control.



No time cams or supplementary instruments are employed. The unit is completely automatic, according to whatever schedule is predetermined by adjustments of four setting knobs on the instrument panel.

In batch dyeing, for example, the controller is said to bring the bath temperature up from any starting point, regardless of daily or seasonal variations, to the desired holding point, and do this at any desired rate of rise from 1 to 8 F per minute. It will hold the bath at the correct temperature for the designated period of time, and then shut off the heat supply, and signal the operator that the cycle has been completed. By reference to the instrument chart and its notations, any cycle can be exactly duplicated as desired, in any similar plant and regardless of season, according to the manufacturer.

Design Engineering Service

No. 2996—A new design engineering service has been established at The H. O. Canfield Co., 129 Housatonic Ave., Bridgeport, Conn., manufacturers of rubber and synthetic rubber products. The function of this service is to study regular and special requirements for component rubber or synthetic rubber parts in practically all industrial fields.

Upon request a careful study will be made of the end use of a manufacturer's product to determine what type of rubber or rubber compound best fills his requirements. Rubber compounds can be formulated to meet many specifications, even resistance to extreme cold and heat in the same item.

Air Separator

No. 2997—Under the trade name "Airfuge," a new separator for removing moisture, oil, scale, etc., from compressed air is announced by The Swartwout Co., 18511 Euclid Ave., Cleveland 12, O. Utilizing the centrifugal principle, the new product is said to provide simplicity of construction and operation and highly efficient separation. Repeated tests, says the manufacturer, show that air delivered is 99 per cent or more free of contamination. Air entering the inlet is diverted positively to the inner wall of the round body and unwanted substances whirl out of the air stream and drain to the bottom. An integral float-operated trap releases condensate automatically. The separator body is made of cast iron, and the interior parts are of corrosion-resisting materials. It is made in three sizes for varying capacities and with a range of pipe connection sizes.

For STOKERS

The CROWN Unbreakable Coal Feed Screw

NOW AVAILABLE for Prompt Delivery

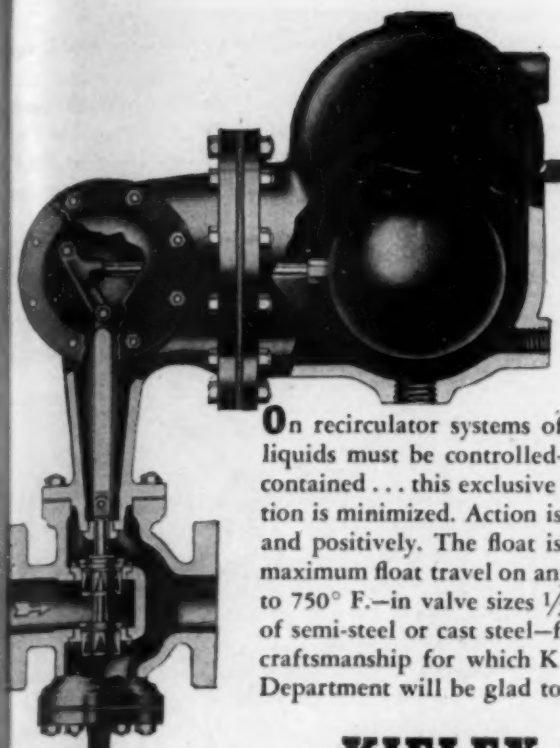
WELDED All-Steel Worm—All Sizes—All Pitches

★ Crown's complete line of all-steel Coal Feed Screws meets every replacement and production requirement. Produced for both domestic and industrial stokers. Crown Screws are available with right or left hand screws, in all sizes and pitches, tapered or straight, and in combinations of pitches. Uniformly smooth surfaces insure that coal will flow freely and easily through the flights. Because it is all-steel with continuous weld, the Crown Coal Feed Screw guarantees long, continuous operation with full customer satisfaction. Crown is in a position to make prompt delivery on all sizes.

In ordering give complete specifications on size and design.

CROWN IRON WORKS COMPANY

1202 Tyler St., N. E. *Since 1878* Minneapolis, Minn.



NO "GLAND TROUBLE"

because UNITROL Level Controller has no packing glands or stuffing box

On recirculator systems of condenser hotwells, deaerators—or wherever the level of liquids must be controlled—UNITROL will do it more accurately! Simple . . . self-contained . . . this exclusive design eliminates trouble-making restrictive elements. Friction is minimized. Action is free and unhampered. Feed or drain is regulated promptly and positively. The float is linked to the inner valve through ratio connection, with maximum float travel on any size valve of only 7 inches. Available for temperatures up to 750° F.—in valve sizes ½" to 4"—integral casting construction—valve and floatcage of semi-steel or cast steel—float of seamless copper or stainless steel—and with the fine craftsmanship for which K & M has been recognized for 75 years. Our Engineering Department will be glad to make specific recommendations.

Write for Catalog 66-C

KIELEY & MUELLER, INC.

MANUFACTURERS OF PRESSURE AND LEVEL CONTROLS

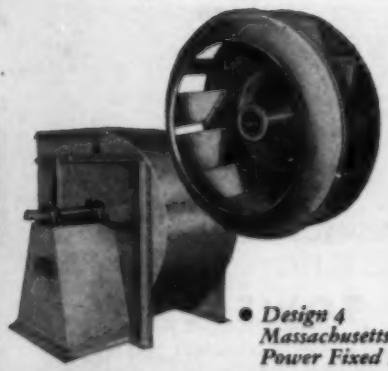
2015 43rd St., North Bergen, N. J.

Awarded our employees for outstanding production achievement

Specify **MASSACHUSETTS**

a Complete and Distinguished Line of

Heating and Air Conditioning Equipment



• *Design 4 Massachusetts Power Fixed Fan*

Backed by 66 Years of Bishop & Babcock manufacturing experience and engineering "know-how"—Absolutely Dependable—Modern Design and Refinements—Wide range of sizes and arrangements—Standard and dependable equipment for all applications—Compact and rugged construction—quiet and efficient in operation—Economical.

• MASSACHUSETTS POWER FIXED FANS • MASSACHUSETTS SQUIRREL-CAGE FANS • MASSACHUSETTS AIR CONDITIONING BLOWERS • MASSACHUSETTS BLOWER TYPE UNIT HEATERS

Write Today for the Catalogues You Need

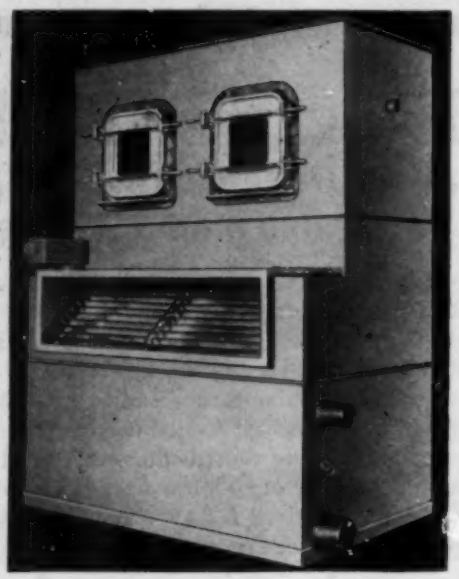
MASSACHUSETTS BLOWER DIVISION

The BISHOP & BABCOCK Mfg. Co.

4901 HAMILTON AVENUE · CLEVELAND 14, OHIO

Industrial Air Conditioning Units

No. 2998—In addition to present units, a vertical contactor of heavy duty construction is offered in the new "Kathabar" unit announced by Surface Combustion Corp., 2375 Dorr St., Toledo 1, Ohio. This unit has been developed for larger industrial applications where control of humidity is necessary to maintain product quality and to insure continuous production.

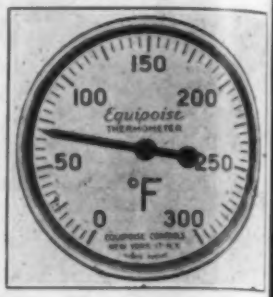


These systems provide a means of dehumidifying-humidifying the air independently of temperature for processing operations and for comfort and are said to be especially useful where low dew point air is required. Units are being used in foundries and in the manufacturing of glass, matches, photographic film, pharmaceuticals, foods and other processing operations requiring air quantities from 10,000 to 70,000 cfm. Smaller package units, from 1350 to 5000 cfm, and large central systems are also available.

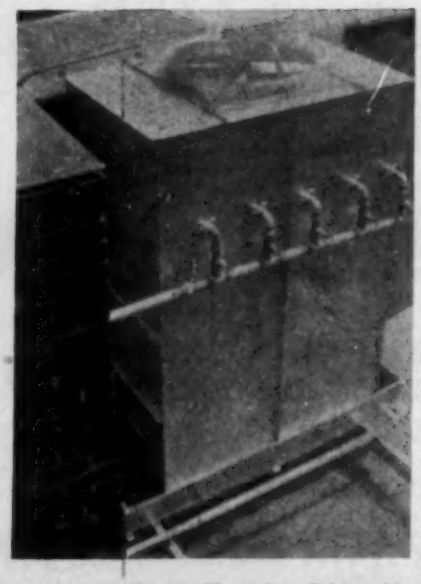
The manufacturer states that some of these processing operations provide conditioned air as low as 19 deg dew point, or about 6 per cent relative humidity at 90 F, and that units have been tested at dew points as low as —80 F.

Bimetal Element Dial Thermometer

No. 2999—A new thermometer is said to feature a permanently calibrated, highly accurate and extremely responsive precision bimetallic helical coil measuring element having a case of alloy steel (in most sizes), and 18-8 stainless steel connection nut and stem. Expansion of the bimetallic coil rotates an attached small shaft and indicating pointer as one unit over the entire scale range. There are no pivots, mechanical linkages or gears. Rugged construction is said to protect thermometer against corrosion, vibration, shock and rough handling and to insure long, dependable service. Various standard ranges are available between limits of —9 F and 1000 F. Test or laboratory thermometers are graduated in both C and F on the same scale. Thermometers are obtainable in 2, 3, and 6 in. dial sizes. The manufacturer is Equipoise Controls, 342 Madison Ave., New York 17, N. Y.



TRAY COOLING TOWERS



COOLING TOWER ABOVE—40 Tons Refrigeration Capacity, 120 GPM, Induced Draft—Outdoor Unit.

SAVE 98% of CONDENSER WATER COSTS wasted thru REFRIGERATION and AIR CONDITIONING PLANTS

ATMOSPHERIC UNIT, WORCESTER, MASS. INDUCED DRAFT COOLING TOWER, PHILA, PA. INDOOR COOLING TOWER, BROOKLINE, MASS.

TRAY COOLING TOWERS *offer*

★ ALL STEEL CONSTRUCTION
★ PACKAGE UNITS—REQUIRE LESS SPACE
★ OPEN DISTRIBUTOR HEADER—NO NOZZLES requires less horsepower for recirculating pumps.
★ INDOOR and OUTDOOR UNITS

Send for BULLETIN 46

Some open territory for factory representatives

NEW ENGLAND COOLING TOWER CO. 89 Broad Street BOSTON 10, MASS.

We Didn't Want to Make Strainers

BUT we needed them for use with Yarway Steam Equipment and couldn't find any to suit us.

So we designed the *YARWAY Strainer.*

Apparently a lot of other people were having "Strainer trouble" because, without a line of advertising, the Yarway Strainers *purchased* in a few years now number *many thousands.*

Why don't you look into this better Strainer for your money? Buy one from your supply house (over 100 Mill Supply Houses now have them).

See its protection against corrosion —*cadmium plating inside and out.*

Examine its *high grade Monel woven wire screen* that stops dirt —lets condensate or other fluids flow freely.

Notice the removeable blow-off bushing. Screen and bushing come out together—go back together, *automatically aligning.*

Six standard sizes from ½" to 2" for pressures to 600 lb.

See your Mill Supply House or write for Bulletin S-200

YARNALL-WARING COMPANY
107 Mermaid Ave. PHILADELPHIA 18, PA.

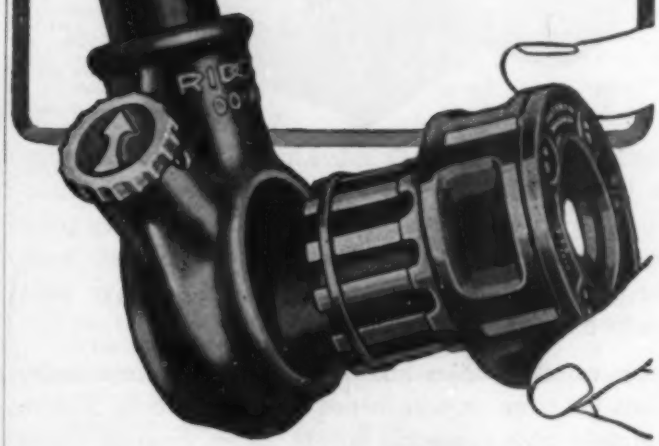
YARWAY STRAINERS

You can cut clean threads quickly... with this rugged, handy, small

RIDGID

RATCHET THREADER

No. 00R & 111R



● Quick and easy does it with this tough little steel-and-malleable ratchet die stock—heat-treated toolsteel dies, precision cut and factory tested, give you smooth perfect threads. Die heads snap in from either side, can't fall out. No special dies are needed for close-to-wall threads. External ratchet No. 00R for ⅛" to 1" pipe, No. 111R for ⅛" to 1¼"—internal ratchet No. 0R for ⅛" to 1," No. 11R for ⅛" to 1¼." For durable efficient work-saver threaders... ask your Supply House for RIDGIDS.

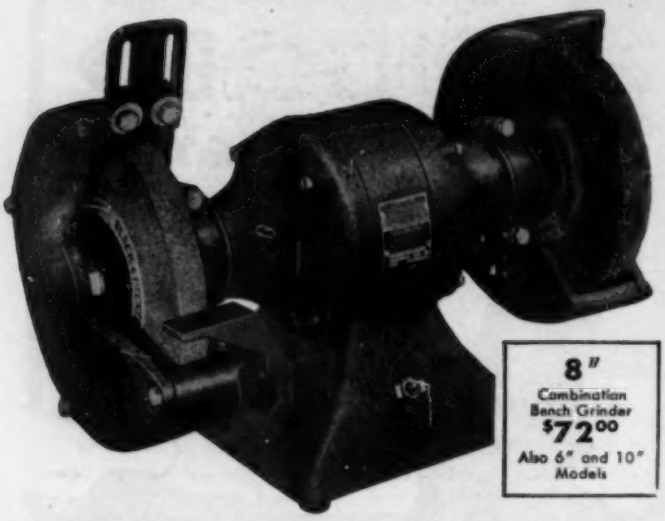
RIDGID

WORK-SAVER PIPE TOOLS

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

Sharper TOOLS! Smoother JOBS!

. . . with Black & Decker BENCH GRINDERS



Black & Decker Bench Grinders keep a keen cutting edge on your tools—help you turn out cleaner work, faster. These Grinders handle many other jobs too! They grind pipe, rings, connections, fixtures, etc.—wire brush, buff, burnish, polish and finish sheet metal—remove weld marks and saw or shear burrs.

Long wheel spindles and tapered end housings make room for large or odd-shaped pieces. Powerful motors maintain high operating speeds under pressure—help you get work done sooner. Many other features.

Ask your Black & Decker Distributor about Black & Decker Bench Grinders and other Electric Tools for heating, piping and air-conditioning work. Or write to: The Black & Decker Mfg. Co., 628 Pennsylvania Ave., Towson 4, Maryland.

"WHIRLWIND"* WIRE BRUSHES

Perfect team-mates for Black & Decker Grinders. Tougher, denser, last longer . . . because each tuft is locked in place to stay. Six wheel sizes: 4" to 12". Three wire sizes. Three thicknesses. Fit almost any arbor or spindle.

*Trade-Mark Reg. U. S. Pat. Off.

LEADING DISTRIBUTORS EVERYWHERE SELL

Black & Decker

PORTABLE ELECTRIC TOOLS

DRILLS • HOLE SAWS • DRILL STANDS • PORTO-SHEARS
BENCH GRINDERS • SANDERS • PORTABLE GRINDERS

Diaphragm Pressure Switch

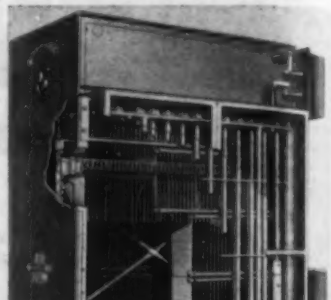
No. 3000—Originally designed to automatically control the intercooler flap on fighter planes, a new diaphragm pressure switch is now available for other applications.

Specifications received from the manufacturer, Aerotec Co., White Plains, N. Y., show a sensitivity of 1/100 in. of water on stationary applications.

This instrument may be adjusted by means of two knobs to any pressure value desired. For accurately determining these pressures, a draft gage may be connected in parallel with the pressure switch.

Self-Cleaning Electronic Air Filter

No. 3001—The new "Model E Electro-Matic" filter now being made by American Air Filter Co., Inc., 107 Central Ave., Louisville 8, Ky., is designed to provide electronic air filtration as an integral function of a self-cleaning air filter. It eliminates the necessity of shutting down the filter for manual cleaning and minimizes the need for personal attention, thus permitting the continuousness of operations.



The positive or charged collector plates are stationary and are supported on heavy insulators affixed to the end plates of the filter housing. The negative or grounded collector plate assemblies are mounted on two endless chains which rotate over top and bottom sprockets to form a continuous movable curtain. The lower part of this curtain is submerged in an oil bath through which it rotates to remove the dust deposit on the negative plates. The small amount of dust collected on the stationary or charged plates is removed by a wiper which is mounted in the rotating curtain and this wiper is, in turn, cleaned as it passes through the oil bath to remove the tarry residue from the negative plates. A wiper is also provided on the oil reservoir. The dust and dirt settling to the bottom of the reservoir as sludge is removed when it has reached the depth of 2 or 3 in. by means of a scraper designed for this purpose and placed in a special sludge pan which engages the front edge of the reservoir holding the cover in an open position to permit the operator complete freedom in using the scraper.

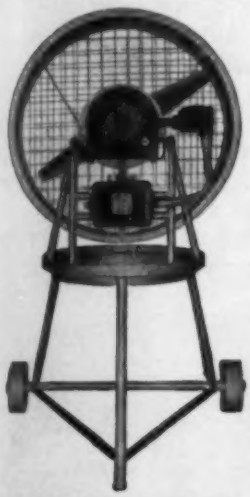
The unit is made in a wide range of sizes, making it possible to meet many space conditions. It uses full height ionizers, which are said to reduce power losses to a minimum due to fewer wire ends. The filter, operating at its normal face velocity of 500 fpm, has an efficiency of 85 per cent by the discoloration test method and at 400 fpm has an efficiency of 90 per cent, according to the manufacturer.

SOUTH BEND AIR PRODUCTS INC
SOUTH BEND INDIANA

Aerospot and Dynaflow

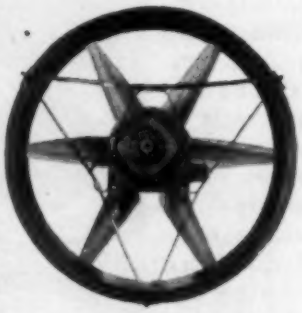
FANS FOR EVERY INDUSTRY

Aerospot and Dynaflow Fans rate high in efficiency and safety features and offer advanced aerodynamic design and rugged construction. The models shown are in most demand for Industrial use. Any unit may be furnished with explosion-proof motor and fan blades. For complete specifications, and listings of other fans available, write for our new catalog today!



HEAVY DUTY AEROSPOT

For general or specific ventilation, man-cooling, or parts-cooling—to increase personnel efficiency and decrease lost time in cooling and drying hot parts. Portable. Direction of blast adjustable. Explosion-proof motor, metal conduit and starter can be supplied. Conforms to state safety regulations.

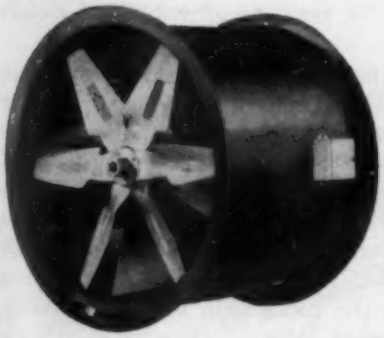


DYNAFLOW UNITS 2-4-6 BLADE TYPES

Six Blade model illustrated. For exhausting or blowing against high static pressures. For general ventilation or specific processes where fumes are present. Sizes: 16 to 36 in. dia. Capacities: 1240 to 26000 c.f.m. Two and four blade models for applications at lower static pressures.

EXTENSION ARM DYNAFLOW FOR "HOT" OR "EXPLOSIVE" GASES

For exhausting explosive gases or fumes . . . For circulating "hot" gases up to 350°F. where temperature is too high to permit use of standard or even special motors. Used in heat exchangers—"sweater" ovens, etc. Fans from 16 to 36 in. diameters.



DUCTYPE UNITS

Direct Drive or Belt Drive

Direct drive model shown; also supplied with belt drive for high temperatures or corrosive air and gas handling. Designed for bolting in any duct run at any point or at either end. Sizes 16 to 36 in. fans.

SOUTH BEND AIR PRODUCTS, INC.

322 EAST COLFAX AVENUE • SOUTH BEND, INDIANA

Why is YOUR Heating System LESS Efficient than it was when new? The answer is SLUDGE, as illustrated above, and not only in pipes but the interior of radiators. valves, traps, etc.

SLUDGE = oil, grease, boiler carryover, oxides, light lime, etc.—

How to remove this sludge from Steam or Hot Water Systems? Some plant engineers try using harmful solutions that attack metal and still do not get proper results. The progressive engineer knows that removing sludge is a difficult job and will call for Rid-Al Service. This Company is experienced in handling difficult cleaning problems economically.

Rid-Al Service consists of three individual treatments for eliminating SLUDGE and all other foreign matter from your entire heating system.

RID-SLUDGE thoroughly cleans all pipe lines, traps, valves, etc.

BOYLOUT cleans the boiler itself.

PROTEX *deposits a protective film* thruout the heating system and retards further deposits. All of the above chemicals are *neutrals, harmless to metals.* Our methods are proven, safe and guaranteed to satisfy. The more difficult the job, the better we can serve you.

RYDLYME,—the answer to another type of problem, is a non-corrosive* oil solvent, which will remove Hard Water scale from indirect hot water heater coils, evaporators, condensers, oil cooling units and other equipment used for heat transfer.

***—Classed as non-corrosive by the United States Bureau of Explosives.**

All of these tested and perfected solutions can be obtained thru Apex Engineering Co.

APEX ENGINEERING COMPANY

Cen. 2909 205 W. Wacker Drive, Chicago 6, Ill. Ran. 7100

We would like "CONSULTATION SERVICE" without cost in solving our cleaning problem which is outlined on attached sheet.

Firm Name .....

Street .....

City ..... State .....

Attention of: .....

IF YOUR BOILER GENERATES 150 H. P. AT 125 LBS. PRESSURE—

THIS JOHNSON *High Temperature* BOILER FEED SYSTEM *SAVES ITS OWN COST IN ONE YEAR*

● To give you a concrete example of the revolutionary savings of this Johnson System, let's suppose that your boiler generates 150 horsepower at 125 lbs. pressure. With the conventional motor driven boiler feed pump, condensate is probably returned to boiler at 170° and pump is driven by a 7½ H.P. motor.

The Johnson System will return condensate at 270° —a 100° increase in feedwater temperature. Since the accepted rule of thumb says that each 11° increase brings 1% saving in fuel, this indicates a 9% total saving in fuel; to allow for all possible losses we'll use a figure of only 8%. To pump water to boiler moreover the Johnson System requires only a 1 H.P. motor, a saving of 6½ H.P. (approximately 4¾ kilowatts every hour it runs).

Here then are the possible savings, based on 10 hours of operation per day, 26 days per month, fuel cost at the average of 45c per 1000 lbs. of steam:

5175 lbs. steam x 10 hours x 26 days x 12 months x 45c per 1000 lbs. x 8%	$581.25
5600 Kw. per year approx., compared to 1200 Kw. = 4400 Kw. x 3c	132.00
	$713.25

These savings pay for the Johnson System in less than one year; and you will save a like amount, less a modest upkeep cost, for many years thereafter. The same proportionate savings are available for all boilers, from 30 to 500 H.P., operating at pressures up to 200 lbs.

Write for full information

The Johnson Corporation

806 WOOD STREET, THREE RIVERS, MICHIGAN

For Low Cost Protection Against Low Water Hazard Ask About The Johnson Automatic Boiler Water Level Control.

Cooling Water Scale Preventive Compound

No. 3002—As an example of the use of "Calgon," a glassy sodium phosphate, in treating cooling water for the prevention of lime scale, the manufacturer cites the experience of a western steel plant. In this plant hot steel billets are pushed along a system of water cooled horizontal pipes and heretofore the average life of these skids was said to be four to five months. Due to the intense heat and the large amounts of cooling water required, calcium carbonate (lime) scale was deposited at a fairly rapid rate so that a pipe which lasted 8½ months was considered to be of unusually long life. Shown here is a section of a skid pipe from the billet heating furnace which is scaled so badly as to seriously impede water flow after 8½ months of service with untreated water. At the left is another section of pipe taken from the same furnace after 8 months of service and after using water treated with 3 parts per million of this material.

This phosphate was developed for applications outside the field of boiler water conditioning, and the manufacturer, Calgon, Inc., Hagen Bldg., Pittsburgh 30, Pa., considers that many applications for this compound exist in the prevention of lime scale in coolers, intercoolers, condensers and various parts of cooling systems which are used in steel plants, oil refineries, power plants, chemical manufacturing plants and many other industries.

Dryer for Air and Gas Lines

No. 3003—A new dryer, "636 Series," for removing moisture from air lines and gas lines is announced by The Gasflux Co., Mansfield, Ohio. This equipment was originally developed to remove moisture from generator acetylene. However, the largest field of application appears to be for the removal of entrained moisture from air lines.

Construction of the dryer consists of an outer shell of 6 in. OD seamless steel tubing and a removable inner shell or cartridge of rolled sheet metal having a perforated metal bottom. A cast bronze head with inlet and outlet openings is bolted to a flange welded to the outer shell. Incoming gas or air must first pass downward between the inner and outer shell, thus trapping out entrained moisture, and then passes upward through the drying medium the full length of the cartridge in order to reach the outlet valve.

Depending upon the drying efficiency that is required there is a choice of three drying media to be used in the cartridge. These are "Fiberglas," calcium chloride, and activated alumina.

tested steel pipe

WHEATLAND steel pipe is put to severe tests to insure perfection before it reaches your hands. One is the hydrostatic test, in which each length is singly tried for leaks or imperfect welds by filling it with water under a pressure of one thousand pounds or more per square inch. This torrent of pressure quickly locates the tiniest hole, and any leaking pipe is rejected.

In other words, before you can test WHEATLAND for satisfaction, WHEATLAND tests itself.

-pipe with the yearmark!

Plant: Wheatland, Mercer County, Pa.
General Offices: Real Estate Trust Building
Philadelphia 7, Pa.

WHEATLAND TUBE COMPANY

8 OUT OF 10
NEW HOME OWNERS SAY...

"We Want Economical Automatic Heat"

Vaporizing Oil Burner Space Heaters, Floor Furnaces, Furnaces, and Water Heaters Equipped with "A-P" CONSTANT LEVEL OIL CONTROLS Deliver This Great Market Right to Your Doorstep

The immediate future is bright for vastly increased installations of Vaporizing Oil Burner Appliances in the millions of attractive new small homes that will shortly be under construction.

The majority of these prospective owners plan to enjoy the comfort of automatic heat and the luxury of automatic hot water — economically and dependably assured by "A-P" Constant Level Oil Controls.

Prepare to promote profitable Vaporizing Oil Burner Appliances sales the "A-P" way — aided by the great advantage of assured leadership with "A-P" Constant Level Oil Controls. Complete Bulletins upon request.

Illustrated is the "A-P" Model 240 W Y P Constant Level Oil Control for water heaters—equipped with "Magic Pilot." The "Magic Pilot" also is available on other model controls for vaporizing burner floor furnaces and furnaces, where a low pilot flame must be maintained indefinitely.

AUTOMATIC PRODUCTS COMPANY
2460 N. 32nd ST., MILWAUKEE 10, WIS.

DEPENDABLE
OIL CONTROLS

"A-P" CONTROLS ARE DESIGNED TO ELIMINATE SERVICING

Internal Plating for Steel Pipe

No. 3004—The inside of steel pipe is now being electro-plated with nickel or other metals by means of a process developed by the Bart Mfg. Co., 227 Main St., Belleville 9, N. J. Developed to endow steel pipe with the corrosion resistance of nickel or other metals, while retaining the relatively low cost, strength, and fabricating characteristics of the former, the process is said to provide a smooth, ductile, and pore-free deposit adherent to the base metal. It can be applied to pipe or tubing up to 18 in. overall diameter, in random lengths of approximately 20 ft.

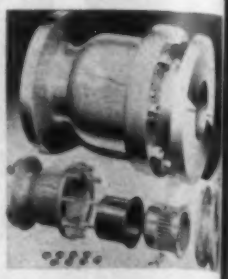
Fittings and pipe line accessories are available. According to the manufacturer, welding and fabricating techniques have been fully developed. It is said this internally plated pipe can be welded, reduced, and bent (hot or cold) without destroying any portion of the internal lining.

Improved Package Type AC Unit

No. 3005—The cabinet type self-contained air conditioning units (from 1 to 5 hp) of the Westinghouse Electric Corp., 653 Page Blvd., Springfield, Mass., have recently been redesigned. Among the features claimed by the manufacturer are: (1) Improved modern appearance, (2) Marked reduction in weight and space requirements, (3) All parts are readily accessible for inspection and servicing, (4) Conditioned air discharge may be either horizontal or vertical and improved blower design provides a reduction in power requirements for the fan motor, (5) The hermetically sealed compressor has been completely redesigned for the 2, 3 and 5 hp models. The cylinders are now arranged in a 90 deg vee with rotating parts dynamically balanced and the use of cast iron in place of a steel shell is said to provide quieter operation.

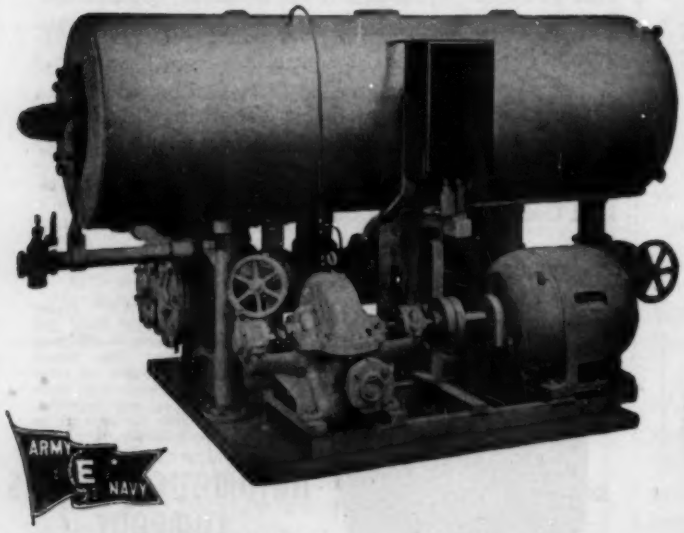
Check Valve Without Metallic Moving Parts

No. 3006—From the standpoint of design, construction and operation, the "Chexflo Valve" is said to offer simplicity and safety. Operation is effected by a synthetic rubber tube stretched over a slotted, cup-shaped metal core, which expands to open and contracts to close. Due to the fact that this expansible tube closes instantly on balanced flow, prior to the commencement of back flow, there is never any tendency to establish pressure impulses, shock, or water hammer through the flow line, according to the manufacturer. Other advantages claimed are: (1) The flexive tube possesses a uniform and constant spring rate which avoids inertia being set up to cause operation beyond flow requirements. (2) It likewise improves in service due to the fact that flexing adds life to rubber. (3) Because of its self-compensating and wear resistant factors this unit is suited for handling corrosive and erosive air, gases or liquids. The valve is offered by the Grove Regulator Co., 1190 67th St., Oakland, Calif.



[*Continued on page* 246]

Boiler Feed Pumping Units



A star has been added to the "E" Award for Walter H. Eagan Company's high achievement in the production of Condensate Return Units.

- For use where boiler feed should be controlled by boiler water level.
- Where operation of boiler water make-up and condensate return is combined.
- In process steam installations where little condensate is returned.

This is one of the various types of Condensate Return Units manufactured by Walter H. Eagan Co. No matter what your requirements, there is an Eagan Unit to do the job.

Write for General Catalog No. 2
Consult us on your requirements

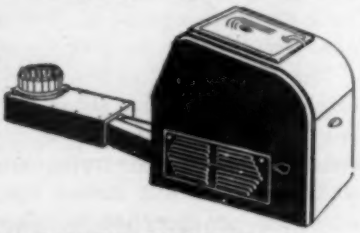
WALTER H. EAGAN CO.

2336-38 FAIRMOUNT AVENUE, PHILADELPHIA, PA.

Peerless

EXCLUSIVE TERRITORY

PEERLESS FIRE-GUARD DISTRIBUTORSHIPS are built on a solid foundation of fair business practice and mutual understanding. No sales quotas nor other *Jokers* in the Peerless franchise. Each Distributor displaying the Peerless Banner is guaranteed full and complete protection throughout his entire territory which is assigned only with every expectation of permanency. These conditions combined with a sensible sales campaign - plus Peerless co-operation - and - plus the existing public demand for the Peerless Fire-Guard Stoker assure Distributor success.



PEERLESS FIRE-GUARD STOKERS

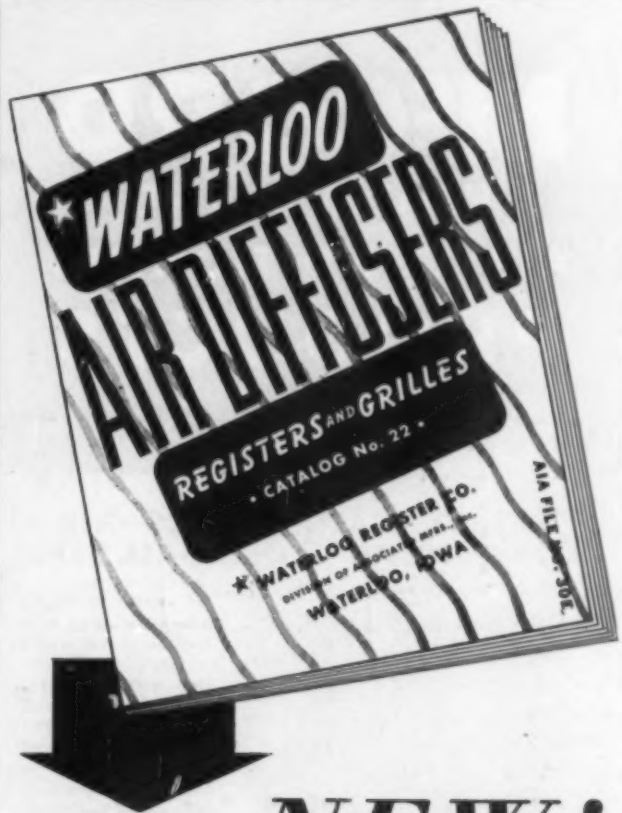
Peerless

MANUFACTURING CORPORATION

INCORPORATED

LOUISVILLE, KENTUCKY

SINCE 1884



IT'S NEW!

—AND YOUR COPY IS WAITING

Send today for this complete catalog and price list—it's up-to-the-minute and complete—gives every detail and fully describes Waterloo Registers and Grilles.

Also includes simplified grille selection data—so you can quickly determine grille sizes for supply and return openings. Now don't forget—but write *right away* for your free copy.

WATERLOO REGISTER DIVISION

ASSOCIATED MANUFACTURERS, INC.

WATERLOO, IOWA

McCORD
HEATING AND AIR CONDITIONING PRODUCTS

BLAST HEATING COILS—AIR CONDITIONING COILS—ALL TYPES

All copper spiral fin tube construction with the tubes formed or bent permits uniform expansion without strain. Headers are heavy wall construction with tubes brazed into extended ferrules formed in the headers. Fins are helically wound and metallically bonded. May we send catalog?

VERTICAL TYPE UNIT HEATERS

A proven heating unit, modern in design, incorporating every unit heater advancement. McCord copper spiral fin tube construction creates air turbulence without undue restriction. Improved fan blades deliver large volume of air with minimum air noise. Guaranteed for 150 lbs. saturated steam pressure. Specify McCord.

HORIZONTAL TYPE UNIT HEATERS

A time proven heating unit, modern streamlined in design, quiet, yet its rugged construction adapts it to all types of installations, guaranteed for use on No. 150 p. s. i. steam pressure. All copper heating element, individual spiral fin tubes free to expand without strain on joints. Standard motors with standard bases used. Wide range of capacities.

Save fuel with McCord Unit Heaters.

McCord CORPORATION
DETROIT 1, MICH.

NEW BOOKS & REPORTS

Vapor Adsorption

To air conditioning and chemical engineers who ar confronted with vapor removal problems this new book Vapor Adsorption, is a valuable contribution to the lit erature. Edward Ledoux, the author, has presented hi material, together with data from other authorities, o this very complex subject in a well organized manner

Although adsorption is the principal topic for analy sis, consideration is also given to the absorption an condensation methods of removing vapors (water vapo and others) from a gas or air. The task of an enginee is to select the method and equipment to meet a partic ular situation. This involves dew point required, avail able sources of energy and their relative costs, available source of cooling water, value of the vapor if it is to b reclaimed, and space or other limitations. The autho has faced the issue by means of typical numerical ex amples.

The first third of the text discusses static adsorption an understanding of which is desirable for design en gineers as well as research chemists and physicists Fundamental relationships for perfect gases and devia tions when analyzing imperfect gases are develope mathematically and compared to observed results. Ca culations are made of the heat of adsorption and desorp tion. This part has not been made easy reading for th application engineer because of the numerous formula developed, the presentation of data in metric terms, an the use of an array of unfamiliar symbols.

Part II is concerned with the saturation of air. It i unfortunate that the author did not use the data on ai and water vapor mixtures as given in the latest issue o the ASHVE Guide. His use of the expression "tota heat" of such mixtures, although correctly defined, ma also result in confusion to an air conditioning enginee The chapters on heat transfer, vapor transfer, and adia batic saturation serve to develop the basic relationship necessary for the succeeding material.

The second half of the book (Parts III and IV) co ering dynamic adsorption and industrial application is of greater useful value to engineers because they ar concerned not with static equilibrium between vapo and adsorbent but rather the rate at which vapor i adsorbed or desorbed before equilibrium is reached Consideration is given to both isothermal and adiabati processes.

There are a number of industrial uses of the adsorp tion principle, including: drying hygroscopic material dehydration of compressed gases, drying of optical in struments, vapor recovery, and air conditioning whe independent control of humidity or extremely low hu midities are required. Data are presented on two com mercially available adsorbents, silica gel and activate alumina, together with discussion of activation method and operating problems. An entire chapter is devote to each major use listed above. There is also an exce lent chapter on the conditioning of underground spac which includes discussion of methods of removing po sonous gases from the air and some practical observ

TYPHOON

PROP-R-TEMP UNITS

PROP-R-TEMP self-contained air conditioning units are a natural for an eager market. Attractive, compact, easy to install, inexpensive to operate, built with the moving parts completely accessible, PROP-R-TEMP represents an achievement in air conditioning engineering. Available in 3 and 5 ton units.

Tested Typhoon equipment for smooth performance in all types of conditioning systems is now available for prompt delivery.

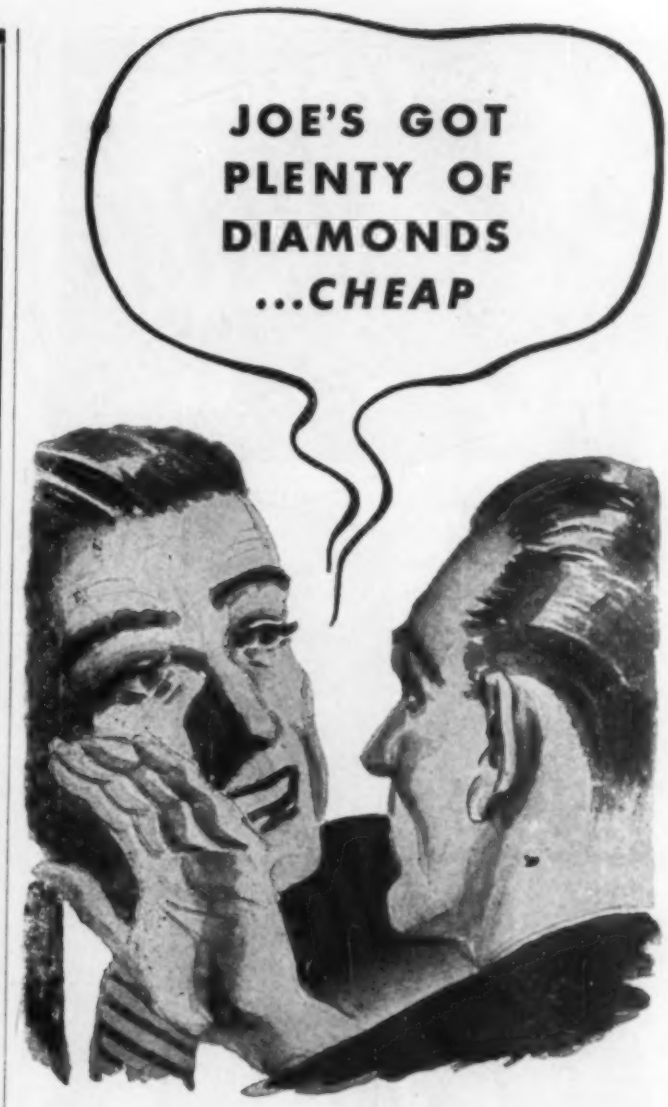
TYPHOON PRODUCTS

- Prop-R-Temp Self-Contained Air Conditioning Units, 3 and 5 Tons.
- TYPHOON Evaporative Condensers.
- TYPHOON Spray Coolers (Air Washers).
- Prop-R-Temp Air Conditioning Units.
- Monsoon Heating Coils (2-Header and Non-Freeze Types).
- Monsoon Direct Expansion Coils.
- Monsoon Water Coils (Continuous Tube and Free Drain Types).

Several dealer territories open. Inquiries and orders receive prompt attention.

ICE-AIR CONDITIONING CO., INC.

794-8 Union Street Brooklyn 15, N. Y.



Most anybody looks on a cut-rate diamond deal with suspicion. The bargain usually fails to materialize.

Carry that suspicion into the field of plumbing supplies the next time you are offered merchandise at big discounts. You may be buying a load of trouble.

In fact, the only safe course is to patronize the reputable jobber in your vicinity who makes a specialty of carrying trustworthy merchandise.

KUHNS BROTHERS CO.

DAYTON 1, OHIO

K

CAST FITTINGS

"K" fittings are carried in stock at Malleable Iron Fittings Co., Branford, Conn.; M. I. F. stocks at Kuhns Bros. Co., Dayton, Ohio.

Every time you install a

BURKS SYSTEM

you create a new

BURKS BOOSTER

BURKS Super Turbine Water System for SHALLOW WELLS

Only Water System with LIFE-LOK! and . . . the BEST BUY in the field!

By giving unfailing service with a minimum of attention, BURKS Water Systems win and hold the affections of their owners. After years of faithful service, a twist of the LIFE-LOK nut brings back "new-like" efficiency. This exclusive BURKS feature, with others, makes BURKS the Best BUY—and the best line to handle.

BURKS Vertical Educer Deep Well System

Write for BURKS *Dealer Proposition*

DECATUR PUMP CO.

41 ELK ST. DECATUR 70, ILL.

tions based on field experience.

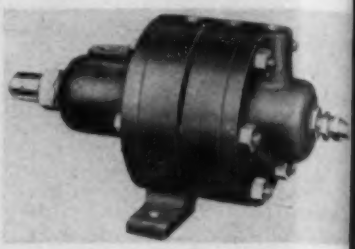
Discussion of dehumidification by condensation (using refrigeration or water) and dehydration by absorption (using hygroscopic salts in aqueous solution or solid form), while somewhat limited, serves to point out the fields of application where such methods are more economic than adsorption.

This text is published by Chemical Publishing Co., Inc., 26 Court St., Brooklyn 2, N. Y. The book has 36[illegible] plus xvi pp., 145 figures and charts, and 10 tables of data. Its price is $8.50. *Reviewed by Realto E. Cherry, Consulting Engineer, Rochester, N. Y.*

[*Continued from page* 242]

Pneumatic Relay and Regulator

No. 3007—The "Type F Totalizer," a pilot-operated pneumatic relay, which may be used to add or subtract loading pressures received from external sources, is manufactured by the Hagan Corp., Hagan Bldg., Pittsburgh, Pa. The device may also be used as a regulator, and in a control system its function depends upon the manner in which the loading pressures are applied to the several diaphragms of the totalizer.



The device may be used in connection with a measuring flow element and a power unit to regulate fluid flow, temperatures, pressure, level, speed, or any other physical condition that can be transformed into a loading pressure as an indication of magnitude.

The manufacturer states that when used as an element in a control system, the totalizer may be used to perform various functions, some of which are as follows: (1) Add or subtract loading pressures, thereby totalizing fuels to a boiler or furnace fired with multiple fuels, or setting up the flow of auxiliary fuels. (2) Average two or more loading pressures, thereby indicating the air requirements for groups of burners or pulverizers. (3) Act as a selector of loading. In a typical application, this action may serve to control fan speed on the basis of the air pressure requirements of the most heavily loaded of several burners. (4) Respond to loading pressures sequentially. This action might be used to set up the sequence of operation of several different burners or fans. (5) Produce anticipating or derivative action. Used in this manner, the totalizer may be applied to overcome the effect of storage in some control applications. (6) Operate as a safety relay. One example is its use to limit the rate of firing of a boiler or furnace to that corresponding to maximum induced draft fan capacity. (7) Act as a pneumatic stop for diaphragm operated valves, receiving regulators, etc. In some cases it may be desirable to limit the maximum or minimum opening of valves or dampers under automatic control without interfering with the ability to move these valves through their entire range under manual control. (8) Invert loading pressures. When used for this purpose, the totalizer will transmit a loading pressure moving in the direction opposite the change in loading received from external sources.

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provide a L-O-N-G step toward TROUBLE FREE Performance

Our long experience in designing and manufacturing V-Pulleys, our complete understanding of their uses, and the finest materials—all are combined in making Maurey V-Pulleys the very best Pulley installations for Refrigeration and Air Conditioning systems as well as for Fans and Blowers.

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THERMOTECHNICS — a new art in temperature detection . . . based upon known phenomena of the expansion and contraction of metals; it includes regulatory media that harness temperatures to industry's bidding; and, it communicates silently and invisibly critical observations by the action of THERMOTECHNICS' unique instrument, the THERMOSWITCH, and directs appropriate action.

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FOR COMPLETE TEMPERATURE CONTROL
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DOUGLASS CONTROL VALVES

SIMPLE • COMPACT
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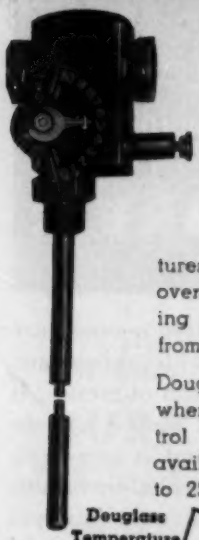

Douglass Temperature Controls are especially recommended for automatically controlling temperature of liquids in such applications as oil de-hydrators or pre-heaters, commercial water heaters, plating tanks, etc, and for atmospheric temperatures in such places as core ovens, cracker ovens, meat packing smoke rooms, paint drying rooms, etc Temperature control range from 65° to 800° F

Douglass Pressure Controls offer ideal service where weight, space and close pressure control are essential factors Control ranges available are for boiler pressures from 5 lb. to 250 lb. and gas pressures to 17" W C.

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SEND FOR DETAILED FOLDER AND PRICES

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Continuous Duty
HORIZONTAL PUMPS
PRECISION-BUILT
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PEERLESS PUMPS

Peerless *(formerly Dayton-Dowd)* Horizontal Centrifugal split case or solid volute pumps, single and multi-stage are found wherever reliability, dependability and economical operating are desired. Engineered and manufactured with a view to long life, Peerless Horizontal Pumps are available for all classes of pumping requirements for high or low heads. The complete line of Peerless Deep Well Turbine, Hi-Lift, Hydro-Foil (propeller), Sewage, and Household pumps are standard for all Vertical pumping conditions.

The right pump for the right job. All inquiries and specifications processed by trained engineers.

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• MEETINGS & CONVENTIONS

NDHA Annual Meeting Scheduled for June 3-6

The 1946 annual meeting of the National District Heating Association will be held at the Cavalier, Virginia Beach, Va., June 3 to 6 inclusive. The headquarters of the association is at 827 N. Euclid Ave., Pittsburgh 6, Pa., and John F. Collins, Jr., is secretary-treasurer.

National Chemical Exposition to Be Held in Chicago

The National Chemical Exposition, sponsored by the American Chemical Society, has been scheduled for September 10 to 14 inclusive and will be held at the Chicago Coliseum, according to an announcement by Dr. H. E. Robinson, chairman of the exposition committee of the Chicago section of the Society.

Since industrial managers, chemists, and engineers are greatly interested in the effects of war time developments on post war products and production, it is expected that the registration of over 21,000 at the last exposition will be exceeded. Marcus W. Hinson, who has managed these expositions since their inception in 1940, will again be exposition manager.

Chicago Production Show and Conference March 20, 21, 22

Production for Profit will be the theme of the Chicago Production Show to be staged next March 20, 21 and 22 at the Stevens hotel, Chicago, by the Chicago Technical Societies Council, according to an announcement by Paul A. Jenkins, executive secretary of the council, 53 W. Jackson Blvd., Chicago 4, Ill.

The show "will emphasize new efficiencies in factory production, and the results of wartime advances in production tools, materials, handling devices, and control instruments." General factory equipment will be exhibited.

Midwest Power Conference April 3-5, in Chicago

The Midwest Power Conference, sponsored by the Illinois Institute of Technology, in cooperation with a number of midwestern colleges and universities and several engineering societies, will be held at the Palmer House, Chicago, April 3, 4, and 5, as announced by Stanton E. Winston, conference director.

Among the papers to be presented at the three-day session will be Centrifugal Compressors, by W. H. Carrier, chairman of the board, Carrier Corp.; Cooling Tower Selection, by J. Lichtenstein, Foster Wheeler Corp.; and Radiant Heating, by T. Napier Adlam, vice-president, Sarco Mfg. Co., Inc.

Included in the program for the first time in 1946 will be a session on the gas turbine discussed by a panel of four speakers, and a paper dealing with the peacetime applications of atomic energy in the power field.

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HANGERS, CLIPS, STRAPS AND BUSHINGS

Expert design, choice materials and controlled manufacture have built "top-service and longest life" into Minerallac Electrical Specialties. That's why the electrical industry "prefers Minerallac"... In steel and Everdur for hanging pipe, conduit, BX cable, etc.

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Forward and Backward Curved Blades
In all sizes, wheels 12 to 72 in.

And forward curve "Juniors" with wheel diameters 6 to 10

The whole story in Bulletin SC-102, with complete performance tables, dimensions, etc.—52 big pages. For your files on request.

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"Lungs for Industry"

Morton Grove, Ill.
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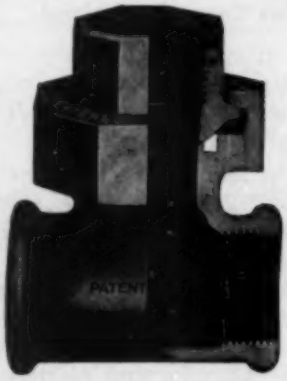
THE UNIONS WITH THE RECESSED BRASS SEAT



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Effect Big Savings in Labor

Jefferson Union Tees with union on the outlet assure labor savings and better piping jobs because they take the place of an all-female union, two nipples and an ordinary tee. Three joints are thus saved. Available in All-Female and Male and Female threads.

The brass seating in these and all Jefferson Specialty Unions is an exclusive feature which, located in a recess away from the runway of the fitting, leaves a straight bore assuring unrestricted flow in the pipe.

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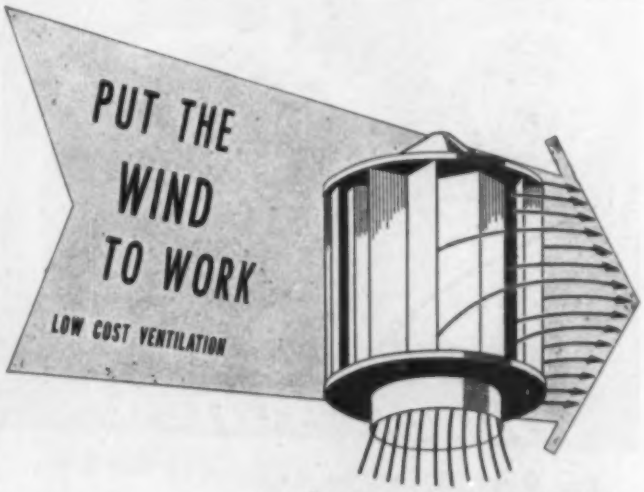

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Applications:

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Toilet Vents
—and many others

With no power or maintenance costs, the Agitair wind-actuated exhauster sucks hot air and fumes out of a building when only a gentle breeze is blowing—no matter which way the wind.

It's simple to mount atop any roof, vent or stack. No back-drafting. Weatherproof. When no breeze, Agitair's wide orifices permit maximum natural ventilation. Ask for Bulletin EX-101.

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We have built, are building, and shall continue to build all types of custom-made coils for air conditioning and refrigeration equipment.

It will cost you nothing to ask us for a quotation on your requirements.

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28-58 Nelson Street

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For Over 20 Years . . . Janette has been building Blower Wheels for discriminating users who realized the importance of equipping their products with wheels of highest quality.

There are 63 single inlet and 22 double inlet wheels available, in 5-inch to 12-inch diameters, from 67 to 4620 c.f.m. capacities.

We Solicit Your Inquiries and the privilege of extending to you the benefits of our long experience in the building of wheels for motorized blowers.

Ask For Bulletin 24-1

Janette Manufacturing Company
556 W. Monroe St. Chicago 6, Ill.

Other Meetings

American Society of Heating and Ventilating Engineers, 52nd annual meeting, January 28-30, Hotel Commodore, New York City. Society secretary, A. V. Hutchinson, 51 Madison Ave., New York 10.

National Metal Congress and Exposition, February 4-8, Public Auditorium, Cleveland.

National Association of Corrosion Engineers, annual meeting; May 7-9, President hotel, Kansas City. Association headquarters, Southern Standards Building, 711 Main St., Houston 2, Tex.

National Marine Exposition; May 20-25, Grand Central Palace, New York City. Headquarters, National Marine Expositions, Inc., 17 Battery Pl., New York City.

American Society for Testing Materials, 49th annual meeting, June 24-26, Buffalo. Annual spring meeting, February 25 to March 1, Pittsburgh.

American Gas Association, conference on industrial and commercial gas; March 29-30, Commodore Perry hotel, Toledo, Ohio.

If you are planning to attend a meeting or convention, it is suggested that you write the headquarters office of the sponsoring society or group for a copy of the program, and information about hotel reservations, etc. The street addresses of the various societies are given above for this purpose. Sometimes the dates or complete plans for such meetings are changed, and it is well, before making your own arrangements, to check with those in charge of the affair to be sure that no such changes will affect your own schedule.

Industries Sales Corp. Organized

Andrew J. Higgins has presented the appliance division of Higgins Industries, Inc., New Orleans, La., to its present operating heads, J. O. Crary, L. V. Busenlener, and W. H. Bramblett.

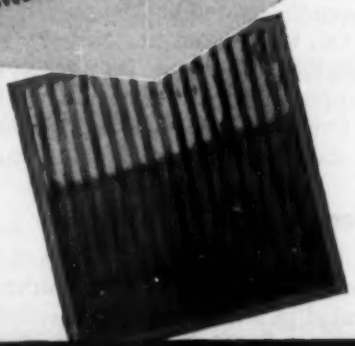
Announcement has been made that the Industries Sales Corp., 521 City Park Ave., New Orleans, La., has been organized and is operating without interruption as distributors of the lines of commercial and domestic products formerly handled by the appliance division. The same retail dealers franchised by the Higgins company in Louisiana, South-Central Mississippi, Southern Alabama and Western Florida will be continued.

Mr. Crary, who served as division manager under the Higgins name, is president of the new company. Mr. Busenlener, formerly manager of the commercial and air conditioning department, is vice-president, and Mr. Bramblett, who headed the Higgins domestic appliance department, is secretary-treasurer. All three are widely known executives in the appliance field.

Coil Manufacturer Expands

The Kennard Corp. reports the opening of its new plant at 2019 S. Hanley Rd., St. Louis, Mo. The firm specializes in the manufacture of air conditioning blower units and coils, heating coils and similar equipment. According to Sam Kennard III, president, the new plant doubles former floor space and is equipped with the modern machinery to facilitate mass production operation.

NEW TURCO METHOD
CLEANS AIR FILTERS IN 15 MINUTES!
STOPS FIRE HAZARD—NO ODOR
NON-INJURIOUS TO METAL
With Turco's new method of cleaning air filters, no special equipment or skilled help is needed. A solution of Turco Aktiv is used in a cold tank. The loosened dirt and grease are easily flushed away with cold water hosing. Filter is dried in stream of air. The Turco Aktiv method has been tested and approved by leading air filter manufacturer.



For complete data write Dept. HPA-1

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TURCO PRODUCTS, INC. - Main Office and Factory: 6135 S. Central Ave., Los Angeles 1 - Offices and Factories: 1606 Henderson St., Houston 10, Tex. - 175 W. 46th St., Chicago 9 - Offices and Warehouses: All Principal Cities

CONTROL PROCESSING TEMPERATURES *Accurately*
STERLING
Control No. 117

WHATEVER your process control requirements, you'll get better results with this single seated, tight-closing, balanced pilot operated valve. Sterling Series No. 117 Control.

Built for steam pressures up to 125 lbs. Sensitive, quick-acting, functioning upon a drop in air or liquid temperature of 1 degree or less. Assures close, dependable regulation of temperature to desired setting.

Available in 3 Sizes—1¼", 1½", and 2" with standard range of 130° to 170° plus other special ranges.

Your JOBBER CAN quote you. Write for latest Bulletin No. 451 covering "Sterling" Temperature Controls.

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Time Delay Relay

Reliable, low cost circuit timing. Positive action with easily adjusted time delay range—from a fraction of a second to several minutes. Write for circular.

AGASTAT

Electro-Pneumatic *TIME DELAY RELAY*

ELIZABETH A'G'A NEW JERSEY
AMERICAN GAS ACCUMULATOR COMPANY

WHY SPEED NUTS ARE FIRST *with management*

Management requests SPEED-NUTS because they improve the quality and prolong the life of product. The same spring tension that produces the exclusive SPEED-NUT lock also absorbs expansion and contraction, vibration and shock, even preventing damage to porcelain enamel, glass or plastic parts. Write today and you'll soon assemble the SPEED-NUT way.

NOTHING LOCKS LIKE A SPEED NUT

As the screw is tightened, the two arched prongs move inward to provide a compensating thread lock against the thread root. Compression of arch in prongs and base creates a *Self-Energizing* spring lock that prevents vibration loosening.

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Speed Nuts

FASTEST THING IN FASTENINGS...OVER 3000 SHAPES AND SIZES

And Keep It Out With

AUTO-VENT AIR ELIMINATORS

Venting Hot Water Unit Heater

Circulation Troubles?

Don't fight air pockets or traps in hot or cold circulating lines! "Get that air out of there" *and keep it out* simply by installing the No. 7 Maid-O'-Mist Automatic Air Vent. This reliable air vent has a self-closing float-controlled valve and is designed especially for circulating pipe lines, concealed radiators, unit heaters, cooling manifolds, tanks, diesel engines, or any other application where air pockets or traps retard the free circulation of liquids. Now available in bright brass finish. For pressures up to 75 pounds.

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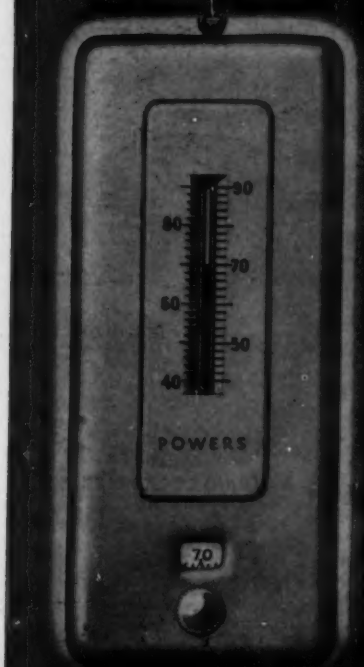
GRADUAL CONTROL has been an outstanding feature of Powers regulation since 1891. With this type of control, valves or dampers are opened or closed gradually, which results in exceedingly close regulation and the maximum of comfort obtainable with automatic control.



● THE POWERS REGULATOR CO., 2759 Greenview Avenue, CHICAGO. Offices in 47 Cities. See your phone book. 42

WRITE FOR BULLETIN NO. 200

POWERS TEMPERATURE and HUMIDITY CONTROL

● RECENT TRADE LITERATURE ●

For your convenience in obtaining copies of these bulletins, see coupon on page 199. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending in your request to Heating, Piping & Air Conditioning.

AC Arc Welding Machines

No. 6043—New and improved Wilson "Bumblebee" a-c transformer arc welding machines are described in a 16 page illustrated booklet published by Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y. Among the machines featured are the 300 and 500 ampere standard and all-weather models and the new 200 ampere unit. Overall dimensions, performance and other pertinent data, and numerous photographs are included.

Air Conditioning Systems

√ No. 6044—The manufacturer's five basic systems of air conditioning multi-room buildings are described and illustrated in a new bulletin (No. 30-F-2) issued by the Carrier Corp., 302 S. Geddes St., Syracuse, N. Y. Conduit and duct type "Weathermaster Systems" are featured. This is the first of 36 new catalogs which will be released by this company.

Arc Welding Accessories

No. 6045—A 12 page booklet (No. 130) illustrating and describing arc welding accessories has been issued by Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y. Equipment such as electrodes, electrode holders, welding cable, shields, goggles, aprons, gloves, cable connectors, and cable lugs are covered. List prices are included and a special section describes the manufacturer's equipment for welding magnesium.

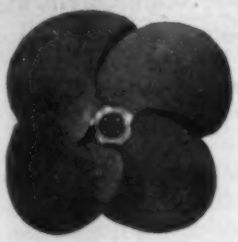
Arc Welding Electrodes

No. 6046—A new 32 page illustrated catalog, issued by the Wilson Welder and Metals Co., 60 E. 42nd St., New York 17, N. Y., furnishes data for the proper selection of the arc welding electrodes offered by that manufacturer. Chemical analyses, specifications, and other pertinent data are supplied for the different electrodes and approved welding procedures for each application are included. The data covers many types of work on a wide variety of base metals, both ferrous and nonferrous.

Boiler Manufacturer's War Production

No. 6047—"The Wartime Story of a Battling Boiler Plant" is a 12 page booklet describing the part which Fitzgibbons Boiler Co., Inc., 101 Park Ave., New York 17, N. Y., played in winning the war. The assembly of tanks, locomotive boilers, gasoline scrubbers, feedwater heaters, and armor plated, prefabricated parts are illustrated. Some of the manufacturer's boilers and heating plants, which are now offered, are also illustrated.

ALUMINUM and PLASTIC



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BETTER FAN satisfaction is assured when you equip your fans with Burden Aluminum or Plastic Blades.

Both are overlapping semi-pressure type. Aluminum Blades mounted on cadmium plated steel hub with steel or aluminum spider. Plastic Blades mounted on steel cadmium plated hub with aluminum spider.

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10 Sizes Made in Both Plastic and Metal

Quietness is an Inherent Characteristic of all Burden Impellers

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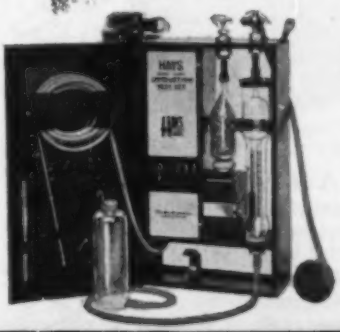
Money going up the flue?

MAKE YOUR OWN CO_2 TEST

You can get an accurate CO_2 reading in 30 seconds—and in 3 or 4 minutes a complete analysis including draft and flue gas temperature, by this handy, accurate Hays Combustion Test Set.

Reveals efficiency of combustion—tells how much money is going up the flue.

A new booklet "ABC of CO_2" is important reading — permits you to figure actual fuel loss. Write for it.



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Model 4-06-C Weight 4 oz. with Plunger. Lift 4 lbs. at 1/16" stroke. Continuous Duty. Current at 24 Volts—.35 Amperes.

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WesCo AC-DC Solenoids are manufactured for all types of Temperature Control and Automatic Control Valves. Made to your specifications. Or our engineers will be glad to consult with you on your problems.

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We are now ready to serve the manufacturers again and invite your request for further information.

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CHROMALOX

Finstrip Heaters

Straight lengths 10½" to 48½" or in single or nested coils as application indicates.

Use Chromalox Electric Finstrip Heaters for hot air blasts in recirculating ovens, drying equipment and many other forced hot air applications. Uniform, thermostatically controlled temperatures up to 750°F. Write for "100 Ways to Use Electric Heat" booklet, Catalog 42 and address of nearest Chromalox Application Engineer.

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CHROMALOX

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SPEED CLAMP ADVANTAGES

1. One piece—no bolts, gears, thumbscrews.
2. Exclusive, self-locking, ratchet design.
3. Faster and easier to install or remove.
4. Uniform pressure provides leak-proof grip.
5. Low profile—no protruding mechanism.
6. May be used over and over again.

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Speed Nuts
FASTEST THING IN FASTENINGS... OVER 3000 SHAPES AND SIZES

Send for Free Sample of
KEY-TITE...
THE LEAK-PROOF SEALER FOR GASKET AND PIPE JOINT CONNECTIONS!

Sealing with Key-Tite will prevent leaks on all lines carrying water, gas, low pressure steam, compressed air, etc. It will not affect the color or taste of potable liquids so consequently can be used freely on piping and equipment where food or beverages are prepared for human consumption.

See for yourself! Send for liberal free sample to be tested in your own plant.

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KEY COMPANY, 2617 McCasland Ave., East St. Louis, Ill.
Gentlemen: Please forward free sample of Key-Tite Waterproof Sealing Compound.
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Chromate Corrosion Inhibitors

No. 6048—A 12 page reprint of Chromate Corrosion Inhibitors in Bimetallic Systems by Marc Darrin, which was published in the August issue of Industrial and Engineering Chemistry, is offered by the Mutual Chemical Co. of America, 270 Madison Ave., New York 16, N. Y. The paper supplements and brings up to date the report issued in 1941 on this subject and the data included cover tests on corrosion scores, weight loss, pitting, pH, and chromate consumption. Practical applications which are described include air conditioning systems, refrigeration brines, diesel engines, and other recirculating and quiescent systems.

Constant Voltage Transformer

No. 6049—A new bulletin (No. 35CV-102) has been released by the Sola Electric Co., 2525 Clybourn Ave., Chicago 14, Ill. A discussion of the construction and theory of the constant voltage transformer together with suggestions pertaining to its practical use are included. The catalog section lists 31 types in capacities ranging from 15 to 10,000 VA.

Corrosion Resistant Facing

No. 6050—Procedures and methods of applying "Hastelloy" facing assemblies to parts of equipment that must resist chemical corrosion are described in a 4 page folder offered by the Haynes Stellite Co., unit of Union Carbide and Carbon Corp., Kokomo, Ind. For application to those surfaces which are exposed to corrosive agents, this nickel-base alloy may be applied directly by the use of welding rods or, for larger surfaces, thin sheets of the metal are welded in place as a protective lining.

Electric Motors

No. 6051—Squirrel-cage induction type and d-c motors ⅛ to 200 hp, wound-rotor induction motors ½ to 200 hp, and single phase capacitor motors ⅛ to 3 hp are described and illustrated in an 8 page bulletin issued by the Star Electric Motor Co., 197 Grove St., Bloomfield, N. J. Also included are gearmotors and brakemotors and many typical applications in various industries are illustrated.

Fans and Blowers

No. 6052—A variety of propeller and centrifugal type fans are described and illustrated in a 59 page catalog (No. 45) issued by the Martin Fan and Blower Co., 4632 W. 21st Pl., Chicago 50, Ill. Both direct and pulley drive fans for general ventilation, exhausting, roof ventilators, and portable use are covered. Centrifugal blowers offered are of the forward, backward and straight blade type and may be obtained in a large number of standard mountings. Exhausters for spray booths, as well as mill type exhausters, are also described.

Heating an Airport Center

No. 6053—A project study, to present the case for central heating at a modern airport center, has been issued in the form of a 17 page booklet, The Airport Center of Tomorrow, by the Ric-Wil Co., 1562 Union

AT-A-GLANCE GAUGES ARE *PREFERRED* BY THE OIL INDUSTRY

because

To assure accuracy AT-A-GLANCE Gauges are NON-ADJUSTABLE, but are accurately adjusted at the factory to fit all sizes of fuel oil storage tanks according to individual specifications. AT-A-GLANCE Gauges are also available for any special sized tanks.

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AT-A-GLANCE Gauges are the easiest reading gauge on the market. That red indicator disc can be seen from any direction and at a great distance.

AT-A-GLANCE Gauges can't be beat for dependability and long life. They contain no gears, magnets, springs nor intricate mechanism to wear out or to get out of adjustment.

AT-A-GLANCE Gauges can be purchased from jobbers throughout the United States and Canada.

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The cheapest method of bending pipe is the one which gives the highest production at the lowest first cost. PEDRICK BENDERS qualify under both of these conditions. A Pedrick Production Bender will save you money because it can be run by inexperienced labor, is relay controlled, and fool-proof. Its production is high and its spoilage is low.

PEDRICK TOOL & MACHINE CO.

3640 N. Lawrence St. **Philadelphia 40, Pa.**

No Waterlogging or Air Binding

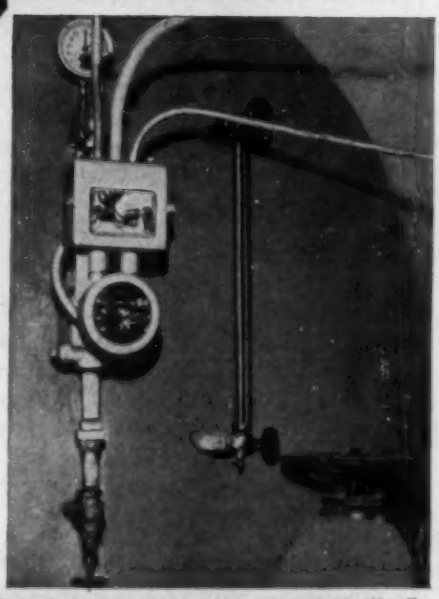
in Hydro-Pneumatic Tanks equipped with

DUOTROL

The DUOTROL maintains high water level at a fixed point and correctly balances air pressure after each pumping operation. It provides a maximum voulme of water with a minimum of pump operation, saving power and reducing wear. Easy to install, stable adjustments.

The DUOTROL shown is on a tank where water at 50° F. is pumped from a 600 ft. well for summer cooling of a complete shopping center. The pressure range is from 30 to 70 lbs.

Ask for Bulletin D-6



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F & T Trap

Vento Radiator Trap

HAINES TRAPS

Haines Float and Thermostatic Traps are designed for any low pressure job up to 20 lbs. in the ¾" size and 30 lbs. in the 1" and 1¼" sizes; they cannot become air bound; the Haines underslung valve principle assures safety. No danger of building up a pressure.

The operating member of Haines Traps — the famous Bourdon Thermostatic Tube — is the strongest ever built into a steam trap. The Bourdon Tube is used in gauges where accuracy is paramount; therefore, Haines Traps always give accurate performance.

Haines Traps are so constructed that they can be examined under pressure. You simply remove the cover and all working parts are before you.

WM. S. HAINES & CO.

460 No. 12th Street

Philadelphia 23

Gehl Stokers in most every state in the union give many years' evidence of outstanding performance. It will pay you to tie up with this established public acceptance. Engineered by experienced stoker specialists—a 79-year-old Company, Gehl Stokers have extra values that are evident in smart designing, fine construction, economy of operation, long life and freedom from service. The Gehl system of coordinated air control produces the maximum in heat units per ton of coal.

Domestic and industrial models now available

Write for literature and dealer plan

GEHL BROS. MFG. CO.

Dept. BA 830. Established 1867. West Bend, Wis.

A GEHL WINS FRIENDS WHEREVER IT GOES

Commerce Bldg., Cleveland 14, O., manufacturers of insulated pipe conduit systems. The hypothetical arrangement consists of an intermediate port strategically located to a number of nearby cities. In addition to hangars, a field operations building, and an administration building, many others, such as a club house, fire station, air freight, and cold storage buildings are planned. Commercial enterprises such as stores, shops, and a hotel are included. It is planned to heat all of these buildings together with those necessary to accommodate a residential community of approximately 500 people by a central system. Consideration is given to the use of radiant heating under one runway and the apron in areas where severe winters and heavy snowfalls are encountered.

Heating System Cleaning Service

No. 6054—The part "Rid-Sludge" service plays in removing light lime, oil, grease, algae, oxides, and boiler carryover from steam distribution systems is described in a 68 p. booklet called The Three Steps which has been issued by Apex Engineering Co., 205 W. Wacker Dr., Chicago 6, Ill. "Ryd-Al" service, which is virtually the same but also provides for cleaning the boiler, is briefly discussed together with the company's procedure for cleaning steam turbines. The booklet contains examples of applications in industrial space heating in the form of testimonial letters. Serving as an introduction to the domestic field, the booklet is written primarily for the home owner.

Heating, Ventilating and AC Equipment

No. 6055—A brief description of the growth of an optical company, an international club, and the modernization of an office building serve to indicate some of the uses for equipment which is offered by the Trane Co., La Crosse, Wis. The November issue of "Weather Magic," the house organ of this manufacturer, also contains a brief discussion of the fundamentals of the reverse cycle refrigeration system.

Leather Packing Standards

No. 6056—Alexander Brothers, 406 N. 3rd St., Philadelphia 23, Pa., have issued a leaflet which contains tabulated data for recommended dimensions of cup, vee, and U shape leather packing. The manufacturer states that these recommendations are offered to industry with the hope that they will be adopted as standards.

Light Weight Pipe

No. 6057—A new 56 page catalog, featuring applications of light weight steel pipe in diameters from 4 to 30 in., has been issued by the Naylor Pipe Co., 1251 E. 92nd St., Chicago 19, Ill. Many applications of this lock-seam spiral welded pipe are shown. Various pipe connections, including a new type coupling, and other fittings, together with the test data, are included. Wall thicknesses from 8 to 14 gage are offered, and for certain applications "Toncan" iron pipe may be ordered in lieu of open hearth steel pipe.

Liquid Gage, Steam Traps, Valves and Fittings

No. 6058—Yarway News, the house organ of Yarnall-Waring Co., 107 Mermaid Ave., Philadelphia 18, Pa., generally features a well known American institution or industrial establishment. A description of the founding,

EVOLUTIONARY IN ENGINEERING

REVOLUTIONARY IN DESIGN

Announcing

THE NEW

COOLSTREAM

Pressure-Bubbler & Bottle-Type

ELECTRIC WATER COOLERS

Superb Engineering
Distinguished Design
***Maximum Efficiency* for**
Minimum Operational Cost

COOLSTREAM — the *first* Water Cooler with a one-piece stainless steel cabinet and a one-piece stainless steel top-plate.

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THE COOLSTREAM CORPORATION
55 West 42nd Street • New York 18.

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Invites Applications from Capable Mechanical Engineers

OPPORTUNITIES are being offered to Engineers who can design and/or prepare engineering drawings for industrial buildings and their facilities. Assignments are not for specific projects but are in our regular engineering staffs in long established offices, located on the East Coast, Central West, Gulf Coast and West Coast.

Positions are open to men possessing a sound background of education and experience and also to recent college graduates qualifying in—

Industrial Plant Equipment • Process Piping • Power Plants • Heating Systems • Air Conditioning and Ventilation • Conveying Systems • Plumbing and Sewers • Sprinkler Systems.

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MULTI-BLADE EXHAUSTERS

Write for details.

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Phillips Float Controls

Another Phillips Product

. . . PILOT OPERATED LIQUID CONTROL VALVE

May be piloted by either float, thermal or electric valve.

The recognized higher efficiency rate of a flooded operated evaporator in a refrigerating or air conditioning system is further emphasized when the evaporator is used in conjunction with Phillips Float Controls. Maximum B. T. U. transfer is assured. These controls respond so instantly to any wide variations in load that their use is indicated on practically all installations. Available capacities: Freon, 20 to 500 tons; Ammonia, 1 to 2000 tons. For high or low side applications. Write for NEW Bulletin.

The Home of Phillips Regulating Valves and Float Controls Established in 1929

H. A. PHILLIPS & COMPANY
1255 W. CARROLL AVE. CHICAGO, ILLINOIS

COMPRESSED AIR LINE PURIFICATION
YOUR PROBLEM?

Here's the Answer...

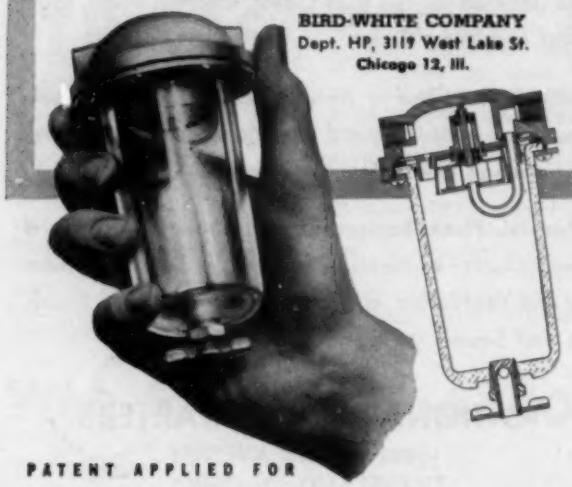
The new Bird-White Pur-O-fier A-1 assures you of positive elimination by turbo-rotor centrifugal action of all free moisture, oil and foreign matter in small compressed air or gas systems. It operates with from 1 to 5 cubic feet of air (1 to 75 p.s.i.) and for intermittent operation is extremely sensitive.

Among many other uses this new unit is ideal for protecting air pressure operated machinery and instruments from corrosion and gumming.

For complete specifications and applications write today for Bulletin No. 11.

Bird-White Pur-O-fiers are also available in other models for purification of large volumes of compressed air or gas. Ask for Bulletin No. 10.

BIRD-WHITE COMPANY
Dept. HP, 3119 West Lake St.
Chicago 12, Ill.



PATENT APPLIED FOR

development, growth, and some interesting historical background are usually included. Vol. 1 No. 3 and Vol 2 No. 1 feature the community of Hershey, Pa. (and the chocolate plant), and the University of North Carolina at Chapel Hill, respectively. Among the manufacturer's products which are described are expansion joints, impulse steam traps, a liquid level indicator, and packing rings for seatless valves.

Rolling Mill

No. 6059—The history, growth, and development of The American Rolling Mill Co., 461 Curtis St., Middletown, O., is described in a 32 page booklet issued by that company. The present size and diversified activities are also covered, and production figures, statements as to earnings and dividends, a consolidated balance sheet, and an income statement for the years 1925 through 1944 are included.

Rotary Pumps

No. 6060—Rotary pumps of the "Bucket Design (swinging vane)" principle in capacities from ⅔ to 750 gpm and for operating pressures up to 500 psi are described in a new bulletin (No. 307) issued by the Blackmer Pump Co., 1920A Century Ave., S.W., Grand Rapids 9, Mich. A new type of removable liner which is now standard construction in the power pumps of this manufacturer is featured.

Safety and Relief Valves

No. 6061—The Farris Engineering Co., 345 Commercial Ave., Palisades Park, N. J., has issued a new catalog

Solve it . . . *with*
SOL-VET "08"
WATER TREATMENT FORMULA

● **SOL-VET "08"** is a fast, efficient cleaner of scale, rust, slime, dirt algae for all equipment using water for cooling. By dissolving impurities completely, they are carried out *in solution* and clogging is eliminated. Head pressures fall to normal; heat transfer is raised to maximum; full circulation is restored; life of equipment prolonged. On large jobs, shutdown time is cut a a maximum of 6 to 8 hours. **GUARANTEED EFFECTIVE.** If you find SOL-VET "08" not exactly as represented, when used according to instruction and full, accurate report is given within 30 days from date of purchase, your money will be refunded. **GUARANTEED HARMLESS** when used as directed, to all water conducting materials in water cooled equipment.

ANDERSON - STOLZ CORPORATION
1731-33 WALNUT ST. KANSAS CITY 8, MO.

DE-STA-CO
Blower Wheel Housings
of Standard Dimensions

Made in sizes to fit 4½, 5, 6, 7½ and 9 inch wheels and in widths to suit single or double inlet wheels . . . also individual parts for your own assembly.

De-Sta-Co housings are engineered for maximum efficiency and quietness in operation . . . neatly finished. Send for "De-Sta-Co Blower Housings" bulletin; gives complete information, including essential dimensions.

DETROIT STAMPING CO.
Established Over 30 Years
337 Midland Ave • Detroit 3, Mich.

(No. 45) describing safety and relief valves. Many new designs and improvements in old models are said to be included. A noteworthy feature of the catalog is the use of an index chart showing line drawings of all the basic types included. Directly opposite the pictorial index is a detailed index showing applications and referencing the catalog location of the complete specifications. A condensed bulletin and price sheet is contained in a supplement (No. 45A).

Spray Nozzles

No. 6062—Yarnall-Waring Co., 107 Mermaid Ave., Philadelphia 18, Pa., has issued a 16 p. bulletin (N-616) illustrating and describing the many types of spray nozzles offered by the company for use in water cooling, air conditioning, and many industrial processes. Dimensions and capacity data of the nozzles together with construction suggestions for spray ponds are included.

Steam Hose

No. 6063—Steam hose for tire recap and vulcanizing molds, together with typical installations, are described in a 4 page bulletin (No. 1500) offered by the Seamlex Co., 27-27 Jackson Ave., Long Island City, N. Y.

Steam Traps

No. 6064—Dimensions, capacities, and list prices are included in a 4 page bulletin describing the "No. 0" steam trap which incorporates a thermostatic air vent, an external test valve for checking the water seal, and which may be ordered in a variety of materials. A 4 page leaflet describes a similar trap, "No. 0A," which is designed for removing condensation from small units.

NOW-PIPE JOINT COMPOUND in Stick Form

FOR ALL THOSE PIPE INSTALLATION AND REPAIR JOBS

Always Ready For Instant Use

NO LEAKS! Just rub 3 or 4 strokes across pipe threads. It spreads and fills threads when turned.

ECONOMICAL HANDY . . . CLEAN

Tested and Fully Approved by Independent Laboratories and Industry.

NO MESS
NO BRUSH
NO WASTE

Note these FEATURES

★ Withstands gasoline, oil, butane, propane, Freon, air, water, steam, acid, gas, brine.

★ Lubricates and completely seals pipe joint threads, nuts, bolts, gaskets, turnbuckles, etc.

★ Contains no lead. Contains no injurious ingredients.

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Lake Chemical Company

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Copr. 1945 Lake Chemical Co.

EFFICIENT ECONOMICAL

De Luxe type WK Pressure Actuated Water Regulating Valves for Freon, Sulphur or Methyl, are pilot operated, modulating. Standard adjustable opening range from 50 to 150 lbs. Factory set to open at 90 pounds. Precision engineering and individual testing for low cost, satisfactory performance. Available in sizes of ¼ to 2 inches FPT. Simple adjustment—easily serviced.

Other sizes and types are also available.

Electrimatic

2100 INDIANA AVE. CHICAGO 16, ILL.

QUALITY always wins! MARTOCELLO Products are fully DEPENDABLE

ATOMIZING SPRAY NOZZLES, SPRAY POND NOZZLES, and CONDENSER WATER DISTRIBUTORS
For Vertical Shell and Tube Ammonia Condensers

ALL MARTOCELLO SPRAY NOZZLES are manufactured with precision and of a design which has been thoroughly tested for maximum results and durability. They are guaranteed to give satisfaction. Successful, efficient results depend largely upon selecting the proper number, type and size of Nozzles suitable for your installation.

THE MARTOCELLO CONDENSER WATER DISTRIBUTORS are now used as standard equipment by Progressive Refrigerating Engineers in solving their Manpower problem, because they require no attention and assure users of the lowest Condenser Operating Pressures and Minimum Power Cost.

It will pay you to consult us. WRITE or WIRE for further information.

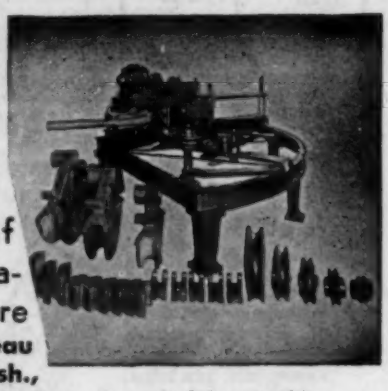
Jos. A. Martocello & Co. 229-231 NORTH 11th STREET PHILADELPHIA 7, PA

MARTOCELLO QUALITY

COLD PIPE, CONDUIT and TUBE BENDING MACHINES

12 types from which to select; hand operated capacities:- ¼ to 6" inclusive; motor operated:- ½ to 8" inclusive. Now indispensable to contractors, shipbuilders, ordnance plants and thousands of others. These machines will be essential also in industrial conversion after the war.

12,000 customers—and more—can testify to the indispensability of "American" machines. Here are **a few users: Bureau of Ships, Wash., D. C.; Henry J. Kaiser Co., Calif:; Pacific Bridge Co.; Bethlehem-Hingham Shipyards; Hercules Powder Co.; Stone & Webster; E. I. Du Pont de Nemours & Co.; Crane Co.**



"American" PIPE BENDING MACHINE Company INC — *Quick Deliveries* — 17 FURNACE ST. BOSTON, MASS.

The Pipe Joint Cement that goes farther

Rutland Pipe Joint Cement gives you more bulk per pound. That means it goes farther and saves money. Seals joints tightly—lasts indefinitely—yet always leaves pipes easy to disjoin. Remains soft in can. Does not stain hands or fixtures.

Mail post card for free sample. Rutland Fire Clay Co., Dept. H-31, Rutland, Vt. Also makers of Rutland Retort Cement, Furnace Cement, Asphalt Paint, Concrete Patcher.

The manufacturer is Swendeman, Inc., 171 Camden St., Boston, Mass.

Test Data on Alloy Steels

No. 6065—Some test results on mechanical properties of Ni-Cr-Mo steels including the 8600 and 8700 series are included in the December issue of Nickel Steel Topics, published by the International Nickel Co., 67 Wall St., New York 5, N. Y. The data are from a paper by Wm. C. Stewart and Richard E. Wiley originally published in the Journal of the American Society of Naval Engineers.

Totally Enclosed Electric Motor

No. 6066—The "SealedPower" motor, available from 2 to 15 hp and rated 55 C rise, full load continuous duty, is totally enclosed and fan cooled. Developed for use in dusty locations and places where excessive moisture is present, the motor may be mounted in either the vertical or horizontal position as sealed ball bearings are incorporated. It is described in a 4 page folder issued by the Crocker-Wheeler Electric Mfg. Co. Div., Joshua Hendy Iron Works, Ampere 1, N. J.

Valve Repair and Replacement Record Sheet

No. 6067—Undoubtedly Jenkins Bros., 80 White St., New York 13, N. Y., are not alone in the thought that many thousands of valves which would normally have been replaced during the last few years, are still in service because all valve production was devoted to high priority use. In addition, many valves are probably in need of repair because of round-the-clock war service, unusual strains, and the lack of maintenance labor. To provide the basis for a simple, organized system of periodic checkups, this manufacturer is offering a set of valve repair and replacement record sheets which are ruled and include captions so that any valve identification number, location, installation and inspection dates may be recorded. Component parts and notations as to the condition of each part at the time of inspection, estimated cost of replacing parts or installing a new valve may be inserted.

Oil Burner Laboratory

In order to increase the heating efficiency of oil burners and fuels and at the same time provide low operational cost to the consumer, Socony-Vacuum Oil Company, Inc., 26 Broadway, New York 4, N. Y., has established a test laboratory as a new unit of the company's technical service laboratories in Brooklyn, N. Y.

Said to be one of the most modernly equipped of its kind, the oil burner laboratory will be used to conduct tests with fuels designed for all kinds of heating units, ranging from plants intended for small homes up to those made to heat large apartments, institutions and office buildings.

The laboratory was established to test new and improved fuels and to provide the most suitable fuels for new equipment as rapidly as both are developed. With the expectation that the post war period will speed developments still further, it is expected the laboratory will contribute materially to the advancement of oil heating.

"COMMERCIAL"
VENTURI TYPE
FAN HOUSING

Twelve sizes now available ... free from die charges.

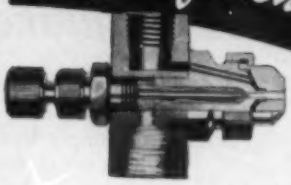
Venture section and support plate are formed in one piece ... no folds or welds.

These sections are formed cold ... dimensions are uniform.

Write for folder giving full dimensions.

THE COMMERCIAL SHEARING AND STAMPING COMPANY
YOUNGSTOWN 1, OHIO

Spray Nozzles
You Can Use with
Confidence!



All Spraying Systems nozzles are designed according to proved hydraulic principles for a particular spray characteristic. Manufactured in thousands of types and sizes to the highest precision standards, they assure maximum efficiency in equipment where liquid spraying plays a part.

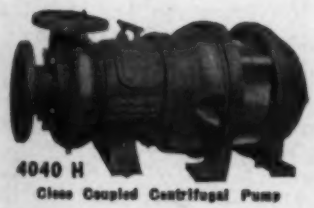
One of the many Spraying Systems Nozzles is shown above. It is an internal mixing, pneumatic atomizing type. This and other spray nozzles are described in Catalog 22. Write for your copy of this free catalog. It contains complete detailed information and reference data to permit selection of the best spray nozzle for every application.

SPRAYING SYSTEMS COMPANY
4033 West Lake Street Chicago 24, Illinois

SPECIALISTS IN THE DESIGN AND MANUFACTURE OF SPRAY NOZZLES

PUMPS
CENTRIFUGAL
RECIPROCATING

IN DEANAPOLIS
IN DEANA



4040 H
Close Coupled Centrifugal Pump

3918
Durable Duplex, Packed Piston Pattern Steam Pump

Centrifugal Pumps
Turbine and Motor Drive Pumps for Handling Most Any Liquids and Service Steam and Power Driven

ESTABLISHED 1869
DEAN BROTHERS PUMPS INC.
INDIANAPOLIS IND.
323 W TENTH ST.

HUMICLEAN
Prevents ALGAE AND SLIME
IN AIR CONDITIONING

NOT A SCOURING AGENT . . .
A Proven Preventive

★ *Reduces Bacterial Content* in air going thru system from 60 to 90%.

★ *Reduces Labor* because frequent cleaning of jets and baffle plates is no longer necessary.

★ *Proved and Accepted*, has been used by large firms for over 4 years.

★ NON-VOLATILE . . . ODORLESS.

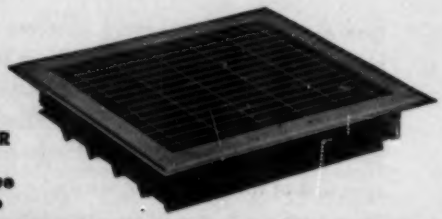
CAROLINA ANILINE & EXTRACT COMPANY
CHARLOTTE 1, N. C.

DuraBilt *Registers & Intakes*

DURABILT Floor Registers and Cold Air Faces have close mesh design in all models—½" by 2" on centers. Surplus strength results from amply heavy materials and rigid cross-bar assembly, the bars which form the face being mortised and locked at every cross joint, and securely interlocked to frame. Frame is welded and reinforced at corners, joints are close fitted and will not pull apart. Entire assembly is extra durable, tight and true, and faces are level and heel-proof. When stout, shock-proof construction is required—use DuraBilt!

To assist you in selecting registers for all purposes, write for Auer Register Book showing complete line of registers and intakes for warm air and air conditioning. Separate Grille Catalog "G" also sent on request.

THE AUER REGISTER COMPANY
3608 Payne Avenue
Cleveland 14, Ohio



AUER REGISTERS
& GRILLES · For Air Conditioning and Gravity

STANDFORATED
PERFORATION OF ALL METALS

REGISTERS and GRILLES
Designed for Heating, Ventilating and Enclosures
Available in all standard sizes or to your specifications.
Write for complete catalog.

STANDARD STAMPING & PERFORATING CO.
3151 W. 49th PLACE CHICAGO, ILLINOIS

MOREY FLOAT VALVE
DESIGNED for Evaporative Coolers, small Cooling Towers, Stock Feeders and many other uses. Morey Float Valves are simple in operation, easy to clean. Made of corrosion-resistant materials. ⅜" pipe connection. Usual trade discounts. Send for sample. *Distributors and Jobbers Wanted.*

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814-816 S. Robertson Blvd.
LOS ANGELES 35, CALIFORNIA

LIST PRICE $2.00

PUBLISHER'S LETTER EXPLAINS PRINTING SITUATION

When the printing strike in Chicago plants last October was settled, after having delayed production of our magazine and forced us to combine the October and November issues, we were assured that future issues would be on schedule. However, that is not working out as expected then, and we again must ask our readers and our advertisers to understand that printing facilities and available manpower in the printing plants are so overtaxed that, dependent as we are on contracting with an outside plant for our production, we are unable to control or adhere to schedules.

Currently, our issues are being printed three to four weeks later each month than our established publication date. The plants got behind and have not been able yet to catch up. All possible measures are being taken to shorten this time but it is apparent now that doing so will be a slow process. There is no question, of course, about being able to publish and mail our magazine every 30 days and, in that respect, you will receive your issues regularly. The job is to get those 30-day intervals back to normal publication dates.

We regret exceedingly the delay and inconvenience that these conditions may have caused and we are sure that they will clear up as time goes on. In the meantime, we thank you for your patience and trust that you will realize that the production troubles in no way affect the content of the magazine and that you will feel, therefore, that the service values of HEATING, PIPING & AIR CONDITIONING are in no way lessened.

—FRANK P. KEENEY, publisher.

Guide to Refrigeration and Air Conditioning Training Facilities

Educational Guide to Refrigeration and Air Conditioning Training Facilities in the United States is the title of a pamphlet recently issued by the American Society of Refrigerating Engineers, 50 W. 40th St., New York 18, N. Y., for the purpose of aiding returning veterans in locating such facilities.

Questionnaires were sent to 208 universities, colleges and vocational or trade schools and returns were received from a total of 167 of these, including 111 colleges or universities and 56 vocational or trade schools.

The guide consists of seven tabulations listing college and university courses, vocational or trade courses, and college or university extension courses, graduate work, laboratory facilities, technical aid for veterans, and correspondence study courses.

The tabulations are listed alphabetically by states and contain sufficient information regarding location, courses offered, credits and prerequisites to enable the prospect to judge whether he is interested in applying to the school for full details of the courses offered.